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THE PLANT DISEASE REPORTER

Issued By

THE PLANT DISEASE SURVEY

Division of Mycology and Disease Survey

BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

AGRICULTURAL RESEARCH ADMINISTRATION

UNITED STATES DEPARTMENT OF AGRICULTURE

SUPPLEMENT 200

PLANT PATHOLOGICAL INVESTIGATION IN THE UNITED STATES

III

Supplement 200 March 30, 1951

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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THE PLANT DISEASE SURVEY
DIVISION OF MYCOLOGY AND DISEASE SURVEY

Plant Industry Station Beltsville, Maryland

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A RÉSUMÉ OF THE ACTIVITIES OF THE MYCOLOGICAL COLLECTIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, WITH A PHYTOPATHOLOGICAL SLANT, 1885-1950

John A. Stevenson

Effective work on plant diseases in the United States Department of Agriculture began in 1885 when F. Lampson-Scribner joined the Division of Botany to head up the newly established Section of Mycology, of which he was in the beginning the entire technical staff. In those far-off days mycology or "applied mycology" and plant pathology were for practical purposes synonymous, early work being largely confined to plant diseases due to parasitic fungi or assumed to be.

It should perhaps be noted in passing that Dr. Thomas Taylor, microscopist of the Department (1871-1896), gave some attention to plant diseases as part of his varied and often bizarre activities, even before the time of Scribner. For the purposes of this account, however, Taylor's studies can be ignored, as practically all other writers on the subject have consistently done, on the grounds that they were of no importance in themselves and without any value as a foundation on which to commence other work.

Obviously Scribner on taking up his duties in the new work took over from the general herbarium, composed largely of flowering plants and which had been building up since 1869, all available fungus specimens to be used as one of his "working tools", and this early collection became at once a repository for fungus materials studied in the Section of Mycology as attested by specimens still to be found in the Bureau of Plant Industry Mycological herbarium. The first published record to this effect appears in Scribner's report for 1887 where as Chief of the Section he notes an herbarium consisting of 9300 labelled fungus specimens mounted on 5572 sheets. He adds that "permanent mounts of microscopical preparations to the number of about 500 were made during the year." Furthermore, a collection of European fungi of the vine was presented by Professor P. Viala, a noted French plant pathologist who spent some time here collaborating with Scribner on grape diseases, and a series of specimens was deposited by W. W. Calkins and S. M. Tracy representing Florida and western collections.

The pathological collections (plant disease material) continued to be maintained and built up as an integral and important part of the work in plant pathology for reference and study purposes, as is evidenced by continued comments in the annual reports of the Department. In 1888, B. T. Galloway, Scribner's successor, writes that, "During the year many new and valuable additions have been made to the herbarium and the number of microscopic mounts of fungi also materially increased."

As recorded in his report for 1891 the fungus herbarium had reached a total of 16,397 specimens mounted on 7865 sheets, representing 779 genera and 6424 species, including the more important exsiccati. By this time, as he notes, "general care of the herbarium requires the work of one assistant, while indexing, filing, and general supervision of the literature consumes a considerable part of the time of another." In this report too, mention is first made of the herbarium catalogue of hosts and fungi, an unique feature then and now of the Bureau mycological collections.

In Galloway's succeeding annual reports, mention of the herbarium is brief and of a general nature, but it was evident that activities outlined in 1891 were continued with direct interest at all times on the part of the Chief of the Division and his staff in maintaining and building up the collections. By 1895, a crisis was reached, which Galloway, writing in later years (Phytopath. 18: 877. 1928) described as follows "The glamour of field service in phytopathology was irresistible so that our collections and herbaria were beginning to languish and our mycological technique becoming rusty. To meet the situation we tried various expedients and made numerous experiments. It was the conviction of my colleagues that our only hope was to find a man, rich in experience, and so wedded to mycology that nothing could swerve him from the beaten path. The experiment was made, but the man failed us".

In this extremity, Mrs. Flora W. Patterson was placed in charge of the fungus herbarium in 1896 with the title of Assistant Pathologist, later changed to Mycologist with the formation of the Bureau of Plant Industry in 1901, and for more than 28 years she devoted herself unceasingly to the building up of the collections. During Mrs. Patterson's regime the unit, operating as a part of the Division of Vegetable Physiology and Pathology and after 1901 as an office of the Bureau of Plant Industry, was designated as Pathological Collections, a designation later (1926) changed to Mycological Collections under which name the unit is at present working.

Previous to Mrs. Patterson's time the herbarium and supporting catalogues or indices were an integral part of the Division of Vegetable Physiology and Pathology along lines already outlined. With Mrs. Patterson's coming or sometime thereafter the fungus herbarium took on a separate status and its history as such begins.

Mrs. Patterson was charged with the duty, as have been her successors, of maintaining and building up the pathological (or mycological) collections and supporting files of the Division of Vegetable Physiology and Pathology and in turn of the Bureau of Plant Industry to serve as a reference collection and source of information on the fungi in general and more particularly on those concerned as causative agents of plant diseases. The herbarium has been a place of deposit for fungus materials studied and reported on by Bureau workers in other Divisions as well as for similar specimens received from many other outside sources. In addition to the obvious duties of curating the herbarium, building up the supporting catalogues and other collateral files, and making an endless series of routine fungus identifications, the mycologist in charge and other staff members have through the years carried on mycological research (usually with a phytopathological bearing) in so far as the above necessary duties have permitted.

Mrs. Patterson and her associate of many years, Miss Vera K. Charles, carried on inspection of all plant materials imported by the Department of Agriculture at Washington for a number of years and particularly those handled by the Office of Plant Introduction of the Bureau. They studied and named the fungi intercepted on such material as a basis for possible quarantine action. These duties were taken over by the Federal Horticultural Board of the Department soon after the passage of the original plant quarantine act of 1912.

For more than half a century the Department of Agriculture has played an important role in the development of techniques for mushroom culture, first in the Division of Vegetable Physiology and Pathology (43) and then in the office or Section of Mycological Collections. Margaret Ferguson's paper (44), published as a joint contribution with the Botany Department of Cornell University, was the first to describe clearly and in detail methods of germinating the spores of cultivated mushrooms and of producing pure culture spawn. Ferguson's work was done under the leadership of B. M. Duggar who, while a collaborator of the Section, was the first in the United States to study the nutritional and other cultural requirements of the cultivated mushroom as well as methods of spawn making (42). He prepared a Farmer's Bulletin (41) on mushroom culture and acted as a consultant on this subject until about 1925. Meanwhile Patterson and her associates maintained an active interest in the problems of mushroom culture as evidenced by the papers of Veihmeyer (123), Charles (17), Charles and Lambert (27), and Charles and Popenoe (28).

Serious and uncontrolled outbreaks of the Mycogone disease in the houses of commercial growers in Chester County, Pennsylvania, led to the establishment in 1928 of a project devoted entirely to the problems of the mushroom industry. This project was headed by E. B. Lambert until its temporary abandonment in 1943. In spite of limited funds the mushroom project was vigorously and fruitfully pursued during this period. A mushroom house was established at Arlington Farm, Virginia, and experimental investigations were carried out on all phases of mushroom culture. Published accounts of this work include papers on the control of Mycogone disease (69), the truffle disease (40), the rose comb disease (70), the plaster molds (27), monosporous cultures of the mushroom (68), plot technique for yield tests (72), casing soil practice (78), and the principles underlying composting practices (74, 75, 77). A critical survey of previous technical contributions in the field was published (73) in 1938, and two comprehensive accounts (71, 76) of mushroom growing with recommendations for improved cultural procedures were issued as Department publications.

To an even greater extent Patterson and Charles were concerned with the mushrooms of the fields and forests. They were continually called on for identification of poisonous and edible species and followed closely mushroom poisoning cases occurring in the local area. Their studies in this field were issued (89, 91) as Department publications which had a wide distribution.

Mrs. Patterson early in her scientific career became interested in the Exoascaceae, an important group of plant parasitic fungi. Her monographic study (85) of the group was published about the time of her coming to the Department. Unfortunately a press of other duties prevented her from pursuing her studies further with this group. She contributed a section on diseases to a Farmer's Bulletin on rose growing (87). The further work of herself and Miss Charles on diseases of ornamentals have been reviewed elsewhere in this series (Plant Dis. Reporter Supp. 195: 438. 1950). Among her other contributions may be mentioned a paper (86) describing 17 new species of fungi parasitic on plants, a note on an edible smut, and again in cooperation with Miss Charles a bulletin (88) on pineapple black rot and a downy mildew of an imported sedge, and finally a paper (90) on the occurrence of bamboo smut in America.

After Mrs. Patterson's retirement Miss Charles continued her work with the wild mushrooms (18) and was in addition for many years a specialist in the identification of entomogenous fungi. She published a number of papers on the subject (21, 22, 25), an interest which culminated in her check list (24) of these fungi for North America. Among her other mycological interests were fungi attacking animals (19, 23) and various new or rare fungi which came to her attention (20, 26).

At the time of Mrs. Patterson's retirement in 1923 the office of Pathological Collections was combined with the Plant Disease Survey, the new unit becoming the Office of Plant Disease Survey and Pathological Collections, later changed to the present Division of Mycology and Disease Survey. Dr. C. L. Shear, upon becoming head of the new office in 1923, continued his mycological and phytopathological studies, the latter nearly always with a distinctly mycological flavor, not only until his own retirement in 1935 but for many years thereafter. His papers were many and varied, including a revision of his bulletin on cranberry diseases (109), general discussions such as his *Mycology, Scientific and Otherwise* (98), *Condition and Needs of Systematic Mycology* (103), *Mycology in Relation to Human Pathology* (93), and a series on mycological nomenclature (94, 99). He was particularly interested in the taxonomy and life histories of the Ascomycetes and their imperfect stages, and of his papers in this field, many with co-workers, there may be cited those dealing with *Tryblidiella*, *Penicillium glaucum*, *Botryosphaeria*, *Godronia*, *Dothiora*, *Physalospora*, and *Pilacre* (96, 97, 102, 104, 105, 106, 108, 110, 111).

His miscellaneous studies in the field were gathered into a series of papers (100) under the general title of Mycological Notes, and he had made a beginning in publishing the results of a life-long study of the Xylariaceae by papers (101) on the genus *Hypoxylon*. He took part in editing the English edition of the classic work of the Tulasnes, *Selecta Fungorum Carpologia*, in three large folio volumes, and collaborated with F. E. Clements in the preparation and publication of the *Genera of the Fungi* (31), the standard book in the field. Similar papers (92, 95, 107) dealing with the Texas root-rot fungus (*Ozonium* (*Phymatotrichum*) *omnivorum*), *Sphaceloma ampelina*, and the *Monilia sitophila* group are worthy of comment. The latter paper with B. O. Dodge touched off the genetical work with these forms, which has now mushroomed into hundreds of titles in the literature on the genetics of the fungi.

Dr. James R. Weir was in charge of the mycological herbarium for the period 1923-1927, but during much of this time was concerned with field studies of rubber and sugar cane diseases, activities outside the scope of this paper.

Studies on the genus *Balansia*, an important group of grass parasites, have been carried on by W. W. Diehl, with a series of papers culminating in a recent monograph (38). Other papers by Dr. Diehl of a plant pathological nature have included studies of the false smut of maize (*Ustilaginoidea*) (46), taxonomy of *Peziza quernea*, (39), the Myriogenospora disease of grasses (35), and a new *Ophiobolus* (84a) on eelgrass, the latter a contribution to the mysterious eelgrass disease problem. In the general field of mycology he has published on mycogeography (36), Fungi of the Wilkes Expedition (33), the genus *Astrocystis* (34), and has collaborated with the Cotton Division in studying fungi concerned in deterioration of fabrics (37, 125).

The genus *Elsinoë* and its imperfect stage *Sphaceloma* have had detailed attention from Dr. A. E. Jenkins over a period of many years. These fungi constitute a group of plant parasites of considerable importance which were obscure and little known until the work of Dr. Jenkins and her co-worker A. A. Bitancourt, now Director of the Biological Institute, São Paulo, Brazil. Their studies, both individual and joint, have brought to light many new species and resulted in a long series of papers among which there may be cited here those dealing with scab and similar diseases of citrus (1, 51, 55), avocado (54), *Canavalia* (48), *Cinnamomum* and *Sesbania* (82), lima bean (49), apple and pear (52), rose (53), violet (84), goldenrod (66), sweet potato (67), Capulin cherry (59), mango (5), tea (2, 64), and cinchona (48). Many other plants of less importance are attacked by members of this genus. A considerable series of additional papers under the joint authorship of these co-workers dealing with the Elsinoaceae may be cited (3, 4, 6, 60, 61, 62, 63, 65). These papers describe new species, present new records of geographical distribution, and make available new data on other phases of the problem. Jenkins and Bitancourt have issued, as a further contribution to the elucidation of this group of fungi, 500 selected specimens representing their work under the title *Myriangiales Selecti Exsiccati*, sets of which have been deposited in ten mycological institutions in Europe, Asia, North and South America.

Dr. Jenkins has been interested also in the genus *Taphrina* but to date has published only her studies on species attacking various species of *Acer* (56). Other studies have included currant cane blight, *Sclerotinia* disease of mulberry (112), leaf spot of *Convallaria* (57), and brown canker (47, 50) and other rose diseases.

Alaskan fungi (8) and the Discomycetes or cup fungi have been the chief research interest of Miss E. K. Cash. Several of her papers (16, 32, 83) on the latter group have been in cooperation with members of the Division of Forest Pathology dealing with species parasitic on trees. Other papers (9, 10, 11, 13, 14) have been concerned with the Discomycetes of Colombia, California, Colorado, Florida, Georgia, and Hawaii. The same worker has also contributed papers on fungi parasitic on Smilax, Ribes, and Libocedrus (7, 12, 15). Particular reference must be made to a study (124), by Miss Waterman of the Division of Forest Pathology and Miss Cash, on a new Discomycete in the genus Septotinia, found in its conidial state causing a very severe leaf blight of hybrid poplars.

Mr. Paul Lentz has been studying the morphology of wood-rotting fungi in the genus Stereum and has published papers (80, 81) on the genus Marssonina on oak and chestnut and on the fungus collections of the late George W. Carver of Tuskegee Institute.

The writer has been involved in a variety of activities since joining the mycological work in 1927. Some of these have resulted in publications more or less pertinent to the present subject. Many of these have been in cooperation with workers in other Divisions of the Bureau, including studies on tobacco blue mold (29, 30), tomato fruit rot (120), cowpea leaf spot (79), and sugarcane fungi (121). A long-continued interest in the plant diseases of other countries resulted in a Department publication (113) on the subject, which is now sadly in need of revision. Annotated lists of the fungi and primarily the plant parasitic fungi of several countries have been brought together in publications (45, 118, 122) issued with collaboration abroad. Contributions to the fungus flora of Nevada (117), and the Shenandoah National Park (114) may also be recorded. With Miss Cash an extensive work (119) dealing with the new fungus names proposed by C. G. Lloyd, whose fungus herbarium forms part of the collections, was published through the Lloyd Library. Studies of parasitic fungi which appeared to be undescribed have been issued in a series under the general title of Fungi Novi Denominati (115). As an aid to stablilization of author's abbreviations used in connection with fungus names a preliminary list of recommended abbreviations was issued (116).

The mycological and pathological collections of the Bureau now consist of a general fungus herbarium with an added unit of virus and other non-mycological specimens, a series of special collections, supporting indexes, a microscopic slide collection, photograph and literature collections, historical reference materials and other pertinent mycological items. The several units total more than 500,000 specimens, thus ranking the collections as second in size in the United States, the Farlow Cryptogamic Herbarium of Harvard University taking first place and the New York Botanical Garden third.

In the general herbarium there has been deposited through the years much of the material worked over by the plant pathologists and mycologists of the Bureau and its predecessor, the Division of Vegetable Physiology and Pathology. Among those whose fungus collections, to a greater or less extent, will be found here are F. Lampson-Scribner, B. T. Galloway, H. J. Webber, M. B. Waite, Erwin F. Smith, W. T. Swingle, David Fairchild, P. H. Dorsett, M. A. Carleton, W. A. Orton, C. R. Ball, F. W. Patterson, C. L. Shear, Geo. G. Hedgcock, Vera K. Charles, N. E. Stevens, J. R. Weir, W. A. Archer, and A. G. Johnson, as well as many other past and present workers in this and the crop divisions of the Bureau.

Many important series of specimens have been received from outside sources by exchange, purchase, or donations, among which may be noted those of J. P. Anderson, Alaska; E. Bethel, Colorado and other western States; G. Bresadola, worldwide; W. W. Calkins, Florida; G. W. Carver, Alabama; F. D. Heald and F. A. Wolf, Texas; H. W. Ravenel, Texas (1869, probably formed the beginning of the herbarium); A. A. Heller, California and Puerto Rico; E. W. D. Holway, Iowa and South America; W. A. Kellerman, West Virginia and Guatemala; A. B. Langlois, Louisiana; J. Lind, Denmark; E. D. Merrill and O. A. Reinking, Philippine Islands; L. W. Nuttall, West Virginia; H. E. Parks, California; E. A. Rau, Pennsylvania; J. Rick, Brazil; A. B. Seymour, Illinois and Massachusetts; R. Sprague, Oregon and North Dakota; P. C. Standley, Central America; F. L. Stevens, Puerto Rico, British Guiana, Ecuador, Panama, Hawaii and the Philippine Islands; John A. Stevenson, Puerto Rico; Thomas Taylor, United States; B. C. Tharp, Texas; S. M. Tracy and F. S. Earle, Mississippi; replicates of the types and other collections of L. Fuckel from the Herbier Boissier, Geneva, Switzerland; fungi of the Wilkes expedition; fungi of the North Pacific Exploring Expedition.

For some years all published exsiccati received, both old and new, have been kept in the original volumes as issued or made up into bound volumes if received as unmounted specimens. This series now totals over 70,000 specimens and has been indexed for ease of reference.

The Forest Pathology herbarium is curated separately in cooperation with the Division of Forest Pathology and consists of some 29,000 specimens resulting from the Bureau's work in that field. This collection is particularly rich in wood-rotting fungi and in the rust fungi of forest trees.

The fungus collections of the Department of Botany of the Smithsonian Institution, consisting of three units, are at Beltsville with the Bureau collections under a cooperative agreement. The most important of these is the C. G. Lloyd Mycological Collection of nearly 60,000 specimens representing the life work of the late C. G. Lloyd of Cincinnati. It includes an excellent representation of the larger fungi of the world, being particularly noteworthy for its Polyporaceae, Xylariaceae, and Gasteromycetes. In addition to the actual specimens this herbarium includes Mr. Lloyd's negatives (about 10,000), his note-books, mycological correspondence, microscopic mounts and related materials. The other Smithsonian units consist of a general collection and the W. H. Long collection of rusts and puffballs, the two totalling about 20,000 specimens.

Other portions of the Bureau collections maintained as separate units include (1), the George L. Zundel collection of smut fungi, (2) insect-attacking fungi (entomogenous), (3) the C. C. Plitt lichen herbarium, (4) the Chinese herbarium, consisting of that portion of the Chinese National fungus collections originally at Nanking, not destroyed by the Japanese, (5) herbarium of sugarcane fungi, (6) herbarium of rubber (*Hevea*) fungi, (7) the E. E. Morse collection of Pacific Coast fungi, (8) a collection of fungi and pathological specimens preserved in liquid, including a classical series of specimens of bacterial plant diseases prepared by Erwin F. Smith and his associates. Particular mention must be made of the Michener herbarium found many years ago in a Pennsylvania attic by C. L. Shear and N. E. Stevens. It consists in large part of portions of the original Schweinitz collections from Carolina and Pennsylvania which Ezra Michener was permitted to take as recompense for his labors in organizing the Schweinitz herbarium at the Philadelphia Academy of Sciences. Many specimens from the M. A. Curtis herbarium as well as Michener's own fungus collections are included.

For many years an alphabetical fungus catalogue has been maintained to facilitate reference to the general herbarium, the various exsiccati series and the several special collections. This is supplemented by a host catalogue. The Lloyd herbarium is catalogued separately. A third catalogue, which has been in progress for nearly 30 years and has reached substantial proportions, cites the place, date, and author of new fungus genera and species and includes new combinations and other nomenclatorial changes. A geographical index to fungi in the general herbarium from all South and Central American countries, Mexico, and the District of Columbia area is under way. Since 1927, the mycological and plant pathological literature of the world has been catalogued in so far as time has permitted. Although obviously far short of complete coverage this catalogue does afford an excellent cross section of published information on the fungi in this field.

The fungus collections, catalogues, reference materials, and all other mycological facilities of the section are readily available to all who may have need to use them.

SELECTED BIBLIOGRAPHY

1. Bitancourt, A. A., and A. E. Jenkins. Sweet orange fruit scab caused by *Elsinoë australis*. Jour. Agric. Res. 54: 1-18, illus. 1937.
2. ______________, and ______________. *Elsinoë theae* causing scab of tea. Arq. Inst. Biol. 10: 193-198, illus. 1939.
3. ______________, and ______________. Thirteen new species of *Elsinoë* from Brazil. Arq. Inst. Biol. 12: 1-20, illus. 1941.
4. ______________, and ______________. New discoveries of Myriangiales in the Americas. Proc. 8th Amer. Sci. Congress, pp. 149-172, illus. 1942.
5. ______________, and ______________. Mango scab. Arq. Inst. Biol. 17: 205-228, illus. 1946.
6. ______________, and ______________. Ten new species of Elsinoaceae discovered in Brazil. Arq. Inst. Biol. São Paulo 19: 93-110, illus. 1949.
7. Cash, E. K. *Godronia urceolus* and other Cenangiaceae on *Ribes*. Mycologia 26: 266-272, illus. 1934.
8. __________. Alaskan fungi. Plant Dis. Reptr. 18: 74-88; 20: 121-123. 1934, 1936.
9. __________. Some Ascomycetes new to California. Mycologia 28: 247-252, illus. 1936.
10. __________. Some new Colorado Discomycetes. Mycologia 28: 297-306, illus. 1936.
11. __________. New records of Hawaiian Discomycetes. Mycologia 30: 97-107, illus. 1938.

12. Cash, E. K. Two species of Hysteriales on Smilax. Mycologia 31: 289-296, illus. 1939.
13. ________. Some Georgia Discomycetes. Jour. Wash. Acad. Sci. 29: 47-51, illus. 30: 299-305. 1939, 1940.
14. ________. Some new or rare Florida Discomycetes and Hysteriales. Mycologia 35: 595-603, illus. 1943.
15. ________. Some new species of fungi on Libocedrus. Mycologia 37: 311-317, illus. 1945.
16. ________, and R. W. Davidson. Some new species of Ascomycetes on coniferous hosts. Mycologia 32: 728-735, illus. 1940.
17. Charles, V. K. Mushroom culture for amateurs. U. S. Dept. Agric. Farmers' Bull. 1587: 1-16, illus. 1929, 1933.
18. ________. Some common mushrooms and how to know them. U. S. Dept. Agric. Circ. 143: 1-59, illus. 1931.,
19. ________. Microsporum of cats causing ringworm in man. Jour. Wash. Acad. Sci. 24: 222-227. 1934.
20. ________. A little known pecan fungus. Mycologia 27: 74-82, illus. 1935.
21. ________. A fungus on lace bugs. Mycologia 29: 216-221, illus. 1937.
22. ________. A new entomogenous fungus on the corn earworm. Phytopath. 28: 893-897, illus. 1938.
23. ________. A ringworm disease of muskrats transferable to man. Jour. Wash. Acad. Sci. 30: 338-344. 1940.
24. ________. A preliminary check list of the entomogenous fungi of North America. Insect Pest Survey Bull. 21: 707-785. 1941.
25. ________. A fungous disease of codling moth larvae. Mycologia 33: 344-349, illus 1941.
26. ________. A Laschia on cabbage palmetto. Mycologia 34: 235-240, illus. 1942.
27. ________, and E. B. Lambert. Plaster molds occurring in beds of the cultivated mushroom. Jour. Agric. Res. 46: 1089-1098, illus. 1933.
28. ________, and C. H. Popenoe. Some mushroom diseases and their carriers. U. S. Dept. Agric. Circ. 27: 1-9, illus. 1928.
29. Clayton, E. E., and John A. Stevenson. Nomenclature of the tobacco downy mildew fungus. Phytopath. 25: 516-521, illus. 1935.
30. ________, and ________. Peronospora tabacina, the organism causing blue mold disease of tobacco. Phytopath. 33: 101-113. 1943.
31. Clements, F. E., and C. L. Shear. The genera of fungi. New York. 1931.
32. Davidson, Ross W., and E. K. Cash. Species of Sclerotinia from Grand Mesa National Forest. Mycologia 25: 266-273, illus. 1933.
33. Diehl, W. W. The fungi of the Wilkes Expedition. Mycologia 13: 38-41. 1921.
34. ________. The genus Astrocystis. Mycologia 17: 185-190, illus. 1925.
35. ________. The Myriogenospora disease of grasses. Phytopath. 24: 677-681, illus. 1934.
36. ________. A basis for mycogeography. Jour. Wash. Acad. Sci. 27: 244-254. 1937.
37. ________. Concerning the identity of Iterson's cellulolytic Mycogone. Mycologia 41: 277-279, illus. 1949.
38. ________. Balansia and the Balansiae, in America. U. S. Dept. Agric. Monograph 4: 1-82, illus. 1950.
39. ________, and E. K. Cash. The taxonomy of Peziza quernea. Mycologia 21: 243-245, illus. 1929.
40. ________, and E. B. Lambert. A new truffle in beds of cultivated mushrooms. Mycologia 22: 223-226, illus. 1930.
41. Duggar, B. M. The cultivation of mushrooms. U. S. Dept. Agric. Farmers' Bull. 204: 1-24, illus. 1904.
42. ________. The principles of mushroom growing and mushroom spawn making. Bur. Pl. Ind. Bull. 85: 1-60, illus. 1905.
43. Falconer, Wm. How to grow mushrooms. U. S. Dept. Agric. Farmers' Bull. 53: 1-19, illus. 1897.
44. Ferguson, Margaret C. A preliminary study of the germination of the spores of Agaricus campestris and other Basidiomycetous fungi. Bur. Pl. Ind. Bull. 16: 1-40, illus. 1902.

45. Garcia Rada, G., and John A. Stevenson. La flora fungosa peruana. Lima, Peru. 112 pp. 1942.

46. Haskell, R. J., and W. W. Diehl. False smut of maize, *Ustilaginoidea*. Phytopath. 19:589-592, illus. 1929.

47. Jenkins, A. E. Brown canker of roses, caused by *Diaporthe umbrina*. Jour. Agric. Res. 15: 593-599, illus. 1918.

48. ____________. Scab of *Canavalia* caused by *Elsinoë canavaliae*. Jour. Agric. Res. 42: 1-12, illus. 1931.

49. ____________. Lima-bean scab caused by *Elsinoë*. Jour. Agric. Res. 42: 13-23, illus. 1936.

50. ____________. Development of brown canker of roses. Jour. Agric. Res. 42: 293-299, illus. 1931.

51. ____________. Development of the citrus-scab oragnism *Sphaceloma fawcettii*. Jour. Agric. Res. 42: 545-558, illus. 1931.

52. ____________. *Elsinoe* on apple and pear. Jour. Agric. Res. 44: 689-700, illus. 1932.

53. ____________. Rose anthracnose caused by *Sphaceloma*. Jour. Agric. Res. 45: 321-337, illus. 1932.

54. ____________. *Sphaceloma perseae* the cause of avocado scab. Jour. Agric. Res. 49: 859-869, illus. 1934.

55. ____________. Australian citrus scab caused by *Sphaceloma fawcettii scabiosa*. Phytopath. 26: 195-197, illus. 1936.

56. ____________. A new host for *Taphrina dearnessii* and geographic distribution of *Taphrina* on North American maples. Mycologia 32: 408-414, illus. 1940.

57. ____________. *Ascochyta majalis* identified on lily of the valley in the United States. Phytopath. 32: 259-261, illus. 1942.

58. ____________. Scab of cinchona in South America caused by *Elsinoë*. Jour. Wash. Acad. Sci. 35: 344-352, illus. 1945.

59. ____________. A new species of *Elsinoë* on Capulin cherry. Jour. Wash. Acad. Sci. 37: 86-89, illus. 1947.

60. ____________, and A. A. Bitancourt. Doenças das plantas causadas por fungos dos generos *Elsinoë* e *Sphaceloma*.

61. ____________, and ______________. Illustrations of South American *Elsinoë* and *Sphaceloma* diseases known up to January 1936. Arq. Inst. Biol. São Paulo 10: 31-60, illus. 1939.

62. ____________, and ______________. An *Elsinoë* causing an anthracnose of Virginia creeper. Phytopath. 32: 424-427, illus. 1942.

63. ____________, and ______________. A new species of *Sphaceloma* causing scab of plantain. Jour. Wash. Acad. Sci. 36: 225-227, illus. 1946.

64. ____________, and ______________. Two scab diseases of tea caused by "*Elsinoë*" and their distribution. Arq. Inst. Biol. São Paulo 17: 67-72, illus. 1946.

65. ____________, and ______________. Diagnosis of the *Elsinoë* of flowering dogwood. Jour. Wash. Acad. Sci. 38: 362-365, illus. 1948.

66. ____________, and H. G. Ukkelberg. Scab of goldenrod caused by *Elsinoë*. Jour. Agric. Res. 51: 515-525, illus. 1935.

67. ____________, and A. P. Viégas. Stem and foliage scab of sweet potato. Jour. Wash. Acad. Sci. 33: 244-249, illus. 1943.

68. Lambert, E. B. The production of normal sporophores in monosporous cultures of *Agaricus campestris*. Mycologia 21: 333-335, illus. 1929.

69. ____________. Studies on the relation of temperature to the growth, parasitism, thermal death point, and control of *Mycogone perniciosa*. Phytopath. 20: 75-83, illus. 1930.

70. ____________. Two new diseases of cultivated mushrooms. Phytopath. 20: 917-919, illus. 1930.

71. ____________. Mushroom growing in the United States. U. S. Dept. Agric. Circ. 251: 1-31, illus. 1932.

72. ____________. Size and arrangement of plots for yield tests with cultivated mushrooms. Jour. Agric. Res. 48: 971-980, illus. 1934.

73. ____________. Principles and problems of mushroom culture. Bot. Review 4: 397-426, 1938.

74. ____________. Indoor composting for mushroom culture. U. S. Dept. Agric. Circ. 609: 1-15, illus. 1941.

75. ____________. Studies on the preparation of mushroom compost. Jour. Agric. Res. 62: 415-422. 1941.

76. Lambert, E. B. Mushroom growing in the United States. U. S. Dept. Agric. Farmers' Bull. 1875: 1-38, illus. 1941.

77. ______________, and A. C. Davis. Distribution of oxygen and carbon dioxide in mushroom compost heaps as affecting microbial thermogenesis, acidity, and moisture therein. Jour. Agric. Res. 48: 587-601. 1934.

78. ______________, and Harry Humfeld. Mushroom casing soil in relation to yield. U. S. Dept. Agric. Circ. 509: 1-11, illus. 1939.

79. Lefebvre, C. L., and J. A. Stevenson. The fungus causing zonate leafspot of cowpea. Mycologia 37: 37-45, illus. 1945.

80. Lentz, Paul L. The genus *Marssonina* on *Quercus* and *Castanea*. Mycologia 42: 259-264, illus. 1950.

81. ______________, and John A. Stevenson. A resumé of the fungus collections of George W. Carver. Plant Dis. Reptr. 32: 195-215. 1948.

82. Limber, P. D., F. G. Pollack, and A. E. Jenkins. *Elsinoë* discovered on *Sesbania* and *Cinnamomum* in the United States. Mycologia 38: 463-472, illus. 1926.

83. Lohman, M. L., and E. K. Cash. *Atropellis* species from pine cankers in the United States. Jour. Wash. Acad. Sci. 30: 255-262, illus. 1946.

84. Massey, L. M., and A. E. Jenkins. Scab of violet caused by *Sphaceloma*. Cornell Univ. Agric. Exp. Sta. Mem. 176: 1-9, illus. 1935.

84a. Mounce, I. and W. W. Diehl. A new *Ophiobolus* on eelgrass. Canadian Jour. Res. 11: 242-246, illus. 1934.

85. Patterson, F. W. A study of North American parasitic Exoascaceae. Iowa Univ. Bull. Lab. Nat. Hist. 3: 89-135, illus. 1895..

86. ______________. New species of fungi. Bull. Torr. Bot. Club 27: 282-286. 1900.

87. ______________, *in* F. L. Mulford. Roses for the home. Farmers' Bull. 750: 32-35. 1916.

88. ______________, and V. K. Charles. Some fungous diseases of economic importance. U. S. Dept. Agric. Bur. Plant Ind. Bull. 171: 1-41, illus. 1910.

89. ______________, and ______________. Mushrooms and other common fungi. U. S. Dept. Agric. Bull. 175: 1-64, illus. 1915.

90. ______________, and ______________. The occurrence of bamboo smut in America. Phytopath. 61: 351-356, illus. 1916.

91. ______________, and ______________. Some common edible and poisonous mushrooms. U. S. Dept. Agric. Farmers' Bull. 796: 1-24, illus. 1917.

92. Shear, C. L. The life history of the Texas root rot fungus. *Ozonium omnivorum*. Jour. Agric. Res. 30: 475-477, illus. 1925.

93. ______________. Mycology in relation to human pathology. Amer. Nat. 61: 151-159. 1927.

94. ______________. (1) Mycological nomenclature in relation to plant pathology. (2) Mycological nomenclature. Proc. 4th Int. Congress Plant Sci. 2: 1225-1226, 1657-1660. 1929.

95. ______________. The life history of *Sphaceloma ampelina*. Phytopath. 19: 673-678, illus. 1929.

96. ______________. Life histories of *Tryblidiella* species. Mycologia 25: 274-285, illus. 1933.

97. ______________. *Penicillium glaucum* of Brefeld refound. Mycologia 26: 104-107, illus. 1934.

98. ______________. Mycology, scientific and otherwise. Mycologia 26: 201-209. 1934.

99. ______________. Uniformity and stability of mycological nomenclature . Mycologia 28: 337-346. 1936.

100. ______________. Mycological notes I-IX. Mycologia 29: 355-363, 30: 580-593, 31: 322-336, 32: 105-111, 32: 541-549, 33: 318-332, 34: 263-273, 35: 469-476, 38: 664-673, 40: 748-759, illus. 1937-1948.

101. ______________. Studies of types and authentic specimens of *Hypoxylon* I, II. Lloydia 8: 245-262, 10: 60-64. 1945, 1947.

102. ______________, and H. F. Bain. Life history and pathological aspects of *Godronia cassandrae* on cranberry. Phytopath. 19: 1017-1024, illus. 1929.

103. ______________, and F. E. Clements. The conditions and needs of systematic mycology. Science 431: 393-395. 1926.

104. ______________, and Ross W. Davidson. The life histories of *Botryosphaeria melanops* and *Massaria platani*. Mycologia 28: 476-482, illus. 1936.

105. Shear, C. L., and Ross W. Davidson. A new species of Dothiora on aspen and willow. Mycologia 32: 105-111. 1940.

106. __________, and B. O. Dodge. The life history of Pilacre faginea (Fr.) Berk. & Br. Jour. Agric. Res. 30: 407-417, illus. 1925.

107. __________, and __________. Life histories and heterothallism of the red bread-mold fungi of the Monilia sitophila group. Jour. Agric. Res. 34: 1019-1042, illus. 1927.

108. __________, and N. E. Stevens. Botryosphaeria and Physalospora in the Hawaiian Islands. Mycologia 21: 313-320, illus. 1929.

109. __________, and __________, and H. F. Bain. Fungous diseases of the cultivated cranberry. U. S. Dept. Agric. Tech. Bull. 258: 1-57, illus. 1931.

110. __________, and __________, and Marguerite S. Wilcox. Botryosphaeria and Physalospora on currant and apple. Jour. Agric. Res. 28: 589-598, illus. 1924.

111. __________, __________, and Marguerite S. Wilcox. Botryosphaeria and Physalospora in the Eastern United States. Mycologia 17: 98-107, illus. 1925.

112. Siegler, E. A., and A. E. Jenkins. Sclerotinia carunculoides, the cause of a serious disease of the mulberry. Jour. Agric. Res. 23: 833-836, illus. 1923.

113. Stevenson, John A. Foreign plant diseases. U. S. Dept. Agric. Misc. Publ. 198 pp. 1926.

114. __________. A preliminary list of the fungi of the Shenandoah National Park, I, II. Claytonia 3: 21-28, 31-35. 1937.

115. __________. Fungi novi denominati - I, II. Mycologia 35: 629-637; 38: 524-533. 1943, 1946.

116. __________. A preliminary list of authors of plant parasites with recommended abbreviations. Plant Dis. Reptr. 28: 366-395. 1944.

117. __________, and W. A. Archer. A contribution to the fungus flora of Nevada. Plant Dis. Reptr. 24: 93-103, 26: 196-197. 1940, 1942.

118. __________, and Martin Cardenas. Lista preliminar de los hongos de Bolivia. Lilloa 21: 77-134. 1949.

119. __________, and E. K. Cash. The new fungus names proposed by C. G. Lloyd. Bull. Lloyd Library 35 (Myc. Ser. 8): 1-209. 1936.

120. __________, and L. P. McColloch. Myrothecium as a tomato fruit rot organism. Plant Dis. Reptr. 31: 147-149. 1947.

121. __________, and R. D. Rands. An annotated list of the fungi and bacteria associated with sugarcane and its products. Hawaiian Planter's Record 42: 247-313. 1938.

122. __________, and F. L. Wellman. A preliminary account of the plant diseases of El Salvador. Jour. Wash. Acad. Sci. 34: 259-268. 1944.

123. Veihmeyer, F. J. The Mycogone disease of mushrooms and its control. U. S. Dept. Agric. Bull. 127: 1-24, illus. 1914.

124. Waterman, Alma M., and E. K. Cash. Leaf blotch of poplar caused by a new species of Septotinia. Mycologia 42: 374-384, illus. 1950.

125. Zuck, R. K., and W. W. Diehl. On fungal damage to sun-exposed cotton duck. Amer. Jour. Bot. 33: 374-382, illus. 1946.

DIVISION OF MYCOLOGY AND DISEASE SURVEY

HISTORY OF PLANT DISEASE RESEARCH IN TEXAS

P. A. Young and G. M. Watkins

The practice of plant pathology in Texas has closely attended the varied interests of farm economy in the State. Much of the land is fairly flat and farming has developed in accordance with conditions of soil type and fertility and rainfall or irrigation water. Climatic variation from north to south and east to west strongly influences the selection of adapted crops. The northern part, known as the Panhandle, and the adjacent areas to the south are a part of the hard red winter wheat belt. In the extreme south a subtropical climate favors a large citrus industry and intensive production of vegetables in the winter. The eastern section rather closely resembles the States to the east in climate, terrain and soils, with the result that the crops grown are similar to those of most Southeastern States, except that tobacco has never established a prominent position in Texas farming. Amid the western grazing lands the development of several important irrigated valleys has extended crop production to the most westward portion of the State, the El Paso Valley along the Rio Grande. Throughout the central part the areas adapted to cultivation are devoted principally to cotton, sorghums, corn, and small grains, with several legumes in use for forage and soil-building. Along the Gulf Coast from Orange to Corpus Christi a belt of flat land about one hundred miles wide, composed of soils generally very high in fertility, is devoted chiefly to rice, cotton, sorghums, and winter vegetables. Departures from the general crop interests of the various sections of the State are noted near the large cities, especially Houston, Dallas, Fort Worth, San Antonio, and El Paso, each of which supports considerable nearby market gardening. In other areas, such as districts in the Panhandle and the adjacent south plains, a combination of abundant water for irrigation and suitable soil qualities is favorable for the production of potatoes and other truck crops.

Considering the entire State, the principal crops are cotton, wheat, flax, sorghums, oats, rice, barley, corn, peanuts, clovers, vetch, winter field peas, lespedeza, alfalfa, cowpeas, nearly all commercial types of citrus, peaches, pecans, figs, strawberries, pears, bramble fruits, potatoes, onions, sweet potatoes, carrots, beans, spinach, table beets, cabbage, cauliflower, broccoli, turnips, watermelon, cantaloupes, squash, tomatoes, peppers, eggplant, and commercial greenhouse and nursery crops. The more serious diseases of a number of these crops have been the subject of continuous, intermittent, or brief terminating research studies by a considerable number of plant pathologists who have worked in Texas. To summarize their activities is the purpose of the following account.

Personnel

No plant pathologist appeared on the staff lists of the Texas Agricultural Experiment Station until 1909. Such studies of plant diseases as were made in the State before that were of brief duration, apparently conducted by the staff in other fields within the Station, or by men of external affiliations. L. H. Pammel, of St. Louis, Missouri, and Ames, Iowa, appears to have been the first of these. Between 1886 and 1889, he made the first technical examination of the destructive cotton root rot and demonstrated its cause to be a non-fruiting fungus which he identified as Ozonium auricomum. The fungus was later described as a new species, O. omnivorum, by C. L. Shear. Dr. Pammel's observations were published as Texas Agricultural Experiment Station Bulletins 4 and 7, in 1888 and 1889. T. L. Brunk, H. S. Jennings, and R. H. Price, horticulturists of the Station, left published accounts of plant diseases, chiefly of fruits, between 1889 and 1902. Price acquired the additional title of mycologist from 1899 to 1902. G. W. Curtis, director of the Station, wrote on alfalfa root rot, finding the cause to be the same as that earlier discovered by Pammel for the cotton disease. A bulletin on crowngall by H. Ness, botanist and horticulturist, was published by the Station in 1917.

F. D. Heald and F. A. Wolf, members of the botanical staff of the University of Texas from 1908 to 1912, made plant disease surveys in the region about San Antonio, publishing their observations in 1912. B. M. Duggar, of the Missouri Botanical Garden, made collecting trips into northeastern Texas in 1914 and 1915 and found the conidial stage of the cotton root rot fungus. Dr. Duggar's discovery led him in 1916 to transfer the organism to Bonorden's conidial genus, Phymatotrichum, as P. omnivorum, by which binomial the fungus is known today.

The subject of plant pathology was first accorded a staff position at the Texas Agricultural Experiment Station in 1909. R. H. Pond, the first incumbent, was succeeded in 1911 by F. H. Blodgett, who held the additional title of physiologist. When J. J. Taubenhaus came to College Station in 1916 as plant pathologist and physiologist, succeeding Blodgett, he found a largely untouched area from which to contribute phytopathological data. He applied a prodigious energy to the gathering and reporting of information on all plant diseases which he observed within the State, to the adaptation of control measures known in older agricultural areas to crops under local conditions, and to special research problems requiring intensive, organized effort. In the latter category may be cited his long and varied studies on Phymatotrichum root rot, and his investigations on diseases of sweetpotatoes and onions. As the foundations grew Dr. Taubenhaus was able to add plant pathologists to his group until there were about twelve at the time of his death in 1937. From 1938 to 1950 the responsibility for leadership in phytopathology in the State was held by A. A. Dunlap. He continued the policy of aggressive attack on the more serious disease problems and performance of a great deal of diagnostic and other public service work as a means of maintaining current knowledge of plant disease conditions in the State. He increased the emphasis on plant physiological approaches to pathological and other problems of crop plants. Considerable effort was directed also to the development of locally adapted crops resistant to major diseases. During Dr. Dunlap's period of service the array of problems related to plant disease control in the State changed somewhat in response to the increased interest in organic compounds as fungicides, defoliants, weed-killers, and growth regulators.

Besides the pioneers and leaders mentioned above a considerable number of other investigators have taken part in plant disease research in the State. Their names, dates of phytopathological work in Texas, and the chief research interests of each are set forth in Table 1. This list includes not only plant pathologists, but certain agronomists, horticulturists, plant physiologists, biochemists, geneticists, etc., who have, in the opinion of the compilers, added importantly to the fund of knowledge of plant diseases in Texas.

Table 1. Persons who have taken part in plant disease research in Texas.

Name	Dates of activity	Research interests in plant pathology
L. H. Pammel	1886-1889	Phymatotrichum root rot
T. L. Brunk	1889	Grape diseases
H. S. Jennings	1890	General
R. H. Price	1892-1902	Fruit and vegetable diseases
G. W. Curtis	1892	Phymatotrichum root rot
H. Ness	1897-1929	Crown gall
F. D. Heald	1908-1912	General
F. A. Wolf	1908-1910	General
R. H. Pond	1909-1911	General
F. H. Blodgett	1911-1916	General
J. J. Taubenhaus	1916-1937	General, Phymatotrichum root rot, sweetpotato diseases, etc.
A. D. Johnson	1916	General
L. J. Pessin	1927-1928	General
B. F. Dana	1927-1931	Phymatotrichum root rot
W. J. Bach	1927-1935	Phymatotrichum root rot
J. P. Lusk	1927-1929	Phymatotrichum root rot
W. N. Ezekiel	1928-1944	Phymatotrichum root rot
G. W. Goldsmith	1928-1940	Phymatotrichum root rot, "live oak disease"
S. E. Wolff	1928-1934	Phymatotrichum root rot
P. R. Dawson	1928-1935	Phymatotrichum root rot
H. V. Jordan	1928-1942	Phymatotrichum root rot
E. R. Collins	1929-1936	Phymatotrichum root rot
I. M. Atkins	1930-	Diseases of small grains
Elizabeth Moore	1930-1949	Phymatotrichum root rot
Leta Henderson	1930-1936	Phymatotrichum root rot
D. R. Ergle	1930-1942; 1944-	Phymatotrichum root rot
S. E. Jones	1930-1950	Eggplant yellows
J. H. Hunter	1931-1940	Phymatotrichum root rot
C. H. Rogers	1931-1943	Phymatotrichum root rot, cotton seed treatments
D. C. Neal	1933-1936	Phymatotrichum root rot
N. E. Rigler	1934-1936; 1938-1943	Phymatotrichum root rot
G. T. Boyd	1934-1937	Rose diseases
L. B. Loring	1934-1935	Vegetable diseases

Table 1. -- (Continued)

Name	Date	Research interests
G. E. Altstatt	1934-1945	Tomato diseases
P. Decker	1934-1935	Phymatotrichum root rot
M. F. Kernkamp	1934-1935	Phymatotrichum root rot
L. E. Hessler	1934-1942	Phymatotrichum root rot
J. E. Adams	1935-1943	Phymatotrichum root rot
G. M. Watkins	1935-	Phymatotrichum root rot, rose diseases, peach diseases, southern blight
E. S. McFadden	1935-	Diseases of small grains
P. A. Young	1935-	Tomato diseases, general
D. C. Bain	1935-1937	Seed treatments
P. T. Riherd	1936-1937	Seed treatments
L. M. Blank	1936-1950	Phymatotrichum root rot, bacterial blight of cotton
G. A. Greathouse	1936-1939	Phymatotrichum root rot
E. C. Tullis	1936-	Rice diseases
G. H. Godfrey	1937-	Nematodes, Phymatotrichum root rot, citrus diseases, vegetable diseases, soil fumigation
A. L. Burkett	1937-1939	Seed treatments
E. W. Lyle	1937-	Rose diseases, Phymatotrichum root rot
S. S. Ivanoff	1937-1945	Spinach diseases, cantaloupe downy mildew
A. L. Harrison	1937-	Tomato diseases, watermelon diseases, peanut diseases
A. A. Dunlap	1938-1950	General, Phymatotrichum root rot, cotton physiology, diseases of ornamentals, 2, 4-D injury
A. L. Martin	1938-1939	Rice diseases
H. Rich	1939-1940	Phymatotrichum root rot
C. Wilson	1939-1941	Phymatotrichum root rot
F. M. Eaton	1940-	Phymatotrichum root rot
C. E. Minarik	1940-1942	Rice diseases
G. KenKnight	1940-1942	Peanut diseases
F. E. Clark	1941-1944	Phymatotrichum root rot
R. B. Mitchell	1941-1944	Phymatotrichum root rot
R. J. Hervey	1942-	Phymatotrichum root rot
N. Higinbotham	1942-1944	Rice diseases
E. F. Paddock	1943-1944	Tomato diseases
S. M. Pady	1943-1944	Disease survey
H. W. Larsh	1943-1944	Disease survey
R. D. Watson	1943-1945	Rose diseases, disease survey
T. J. Nugent	1946	Spinach diseases
E. M. Hildebrand	1946-1949	Bacterial diseases
D. H. Bowman	1946-1948	Corn diseases
O. H. Calvert	1948-	Spinach diseases
L. S. Bird	1948-	Bacterial blight of cotton
M. D. Whitehead	1949-	Corn diseases
D. W. Rosberg	1949-	Pecan diseases, onion storage diseases
N. F. Clapp, Jr.	1949-	Rose diseases
H. T. Michael	1949-	Tomato diseases
Frances H. Brite	1950-	White tip of rice
H. R. Hudgins	1950-	Peanut kernel defects

Research

Through the decades since Dr. Pammel's observations in 1886-1889, the Phymatotrichum root rot of cotton and other crops has received the greatest sustained attention of all plant diseases known in the State. The studies of Pammel, Duggar, Taubenhaus, and many others resulted in a fund of detailed knowledge about the geographical occurrence of the organism in Texas, its relation to climate and soil type, its very extensive host range and the losses inflicted on crops. C. H. Rogers, working at Temple, developed techniques and apparatus for determining numbers of sclerotia in large samples of soil, and conducted numerous studies relating sclerotial residues in the soil to various rotations, soil amendments and tillage practices. Data on various aspects of the nutrition of P. omnivorum were accumulated independently by C. H. Rogers, W. N. Ezekiel, and L. M. Blank. The processes by which the fungus enters the roots of cotton and other plants were examined by G. M. Watkins. Alkaloids and other constituents of root tissues as factors in the resistance of certain species were the subject of intensive investigation by G. A. Greathouse and N. E. Rigler. P. R. Dawson, J. E. Adams, L. E. Hessler, D. R. Ergle, H. V. Jordan and others at the U. S. Department of Agriculture Soil Fertility Laboratory at Austin, studied soil chemistry in relation to the prevalence and activity of P. omnivorum. G. W. Goldsmith, Elizabeth Moore, Leta Henderson, and others at the University of Texas devoted many years to various physiological and genetic aspects of cotton root rot. F. M. Eaton, N. E. Rigler, D. R. Ergle, and H. E. Joham have contributed extensive experimental data on the nutrition of the cotton plant and the level of carbohydrate reserves and other chemical factors within the plant in relation to cotton root rot. F. E. Clark, R. B. Mitchell and R. J. Hervey have analyzed the soil microflora in connection with various cultural practices designed to suppress the activity of P. omnivorum.

In the years following the discovery by C. J. King at Sacaton, Arizona, that Phymatotrichum root rot was strikingly controlled by very heavy applications of manure to infested soil, much attention was devoted to the development of a practical adaptation of Mr. King's principle suitable for use under conditions in Texas. The rather highly mechanized farming methods in use in the cotton areas of the State make manure a scarce commodity. From 1942 to 1946 E. W. Lyle, working at Temple, and L. M. Blank, conducting field experiments at various points in central Texas, demonstrated that the use of adapted winter legumes, planted in the fall and plowed under to decay a month before cotton planting time in the spring, would practically eliminate losses from Phymatotrichum root rot. The method has become standard farm practice in many parts of Texas.

Next to Phymatotrichum root rot bacterial blight (Xanthomonas malvacearum) is probably the most important cotton disease in the State. In many years serious midsummer defoliation results from the angular leaf spot phase of the disease. The work of C. H. Rogers at Temple showed that acid-delinting of seed, followed by treatment of organic mercury dusts, caused substantial reduction in seedling infection. Several years ago L. M. Blank initiated a program of introducing the resistance found in Simpson's Stoneville 20 into the major commercial varieties in use in Texas. The program, which has made use of standard plant breeding techniques, is being carried on by L. S. Bird, who has made studies of the inheritance of resistance. Considerable progress toward the development of blight-resistant strains of cotton has been made by D. R. Hooton and D. D. Porter, of the U. S. Cotton Field Station at Greenville.

For many years downy mildew (Pseudoperonospora cubensis) has been a major disease of commercial cantaloupes in south Texas. S. S. Ivanoff, working at Winter Haven, developed a new melon, released in 1945 as Texas Resistant No. 1, which possessed marked resistance to downy mildew and aphids. G. H. Godfrey, of the Lower Rio Grande Valley Experiment Station, has devoted several years to the development of new lines of cantaloupes based on crosses of good commercial types with a local wild cucurbit which is immune from downy mildew. Several of Dr. Godfrey's selections are presently in advanced tests at various locations in south Texas.

The so-called milo disease, caused by Periconia circinata, began to be observed as an important factor in the production of certain varieties of grain sorghum in northwest Texas about 1935. Although the pathogen was then unknown, R. E. Karper and J. R. Quinby, who observed the disease in connection with extensive sorghum breeding work going forward under their direction at Lubbock and Chillicothe, were able to select resistant sorghums and incorporated adequate resistance or tolerance into commercial varieties within a relatively short time.

An important commercial nursery area has existed for many years at Tyler, with rose bushes the principal product. E. W. Lyle conducted extensive experiments to develop adequate means of controlling black spot (Diplocarpon rosae), the chief disease of roses in the area. The system developed by Dr. Lyle of dusting nursery plants throughout the growing season with mixtures of sulfur and fixed copper compounds has been universally successful and is now standard practice among producers in east Texas.

Workers in the State have participated actively for many years in the coordinated regional efforts to combat rusts and other diseases of small grains through the development of resistant varieties. The leaders in this program within the State have been E. S. McFadden and G. W. Rivers at College Station and I. M. Atkins at Denton. Diseases of rice have been investigated at Beaumont since about 1936 by E. C. Tullis, A. L. Martin, C. E. Minarik and Noe Higinbotham.

Frances H. Brite is currently studying the use of fumigants as a means of preventing seed transmission of the nematode causing white tip.

The Texas Agricultural Experiment Station has entered recently into the southern regional program to conduct coordinated breeding work with corn, a portion of which involves resistance to major diseases. Research on corn diseases in Texas was initiated by D. H. Bowman and is being continued by M. D. Whitehead.

The lower Rio Grande Valley is an area characterized by intensive farming and an unusual diversity of crops. Plant diseases are ever present and often become limiting factors in production. G. H. Godfrey, who has served as plant pathologist at the experiment station at Weslaco since 1937, has confronted perhaps as great an array of plant disease problems there as ever faced any worker in the field. Although Dr. Godfrey's chief life-long research interest has been in phytopathogenic nematodes, the following partial list of his activities in Texas will suggest to some extent the breadth of every-day problems which have claimed his attention.

1. The discovery of Rio Grande gummosis of citrus, which he believes may be caused by an actinomycete.
2. Project leader of the current program to eliminate psorosis and other viruses from citrus by careful selection of budwood and maintenance of test nurseries.
3. Work with combination sprays and dusts, or "mist-dusts", for improving the adhesion of fungicides.
4. A study of stalk rot of corn, caused by _Pythium butleri_.
5. Experiments with new organic compounds for the control of late blight of potato.
6. Cultural control of root-knot nematodes by successively deeper plowings during hot, dry weather, especially applicable to short-season crops.
7. Development of a non-phytotoxic wound paint useful in surgery on citrus and other trees.
8. Use of nucleus colonies of bees for field selfing of cantaloupes under portable insect cages.
9. Correction of lime-induced chlorosis of citrus by means of manure composted with sulfur.
10. Identification of the citrus nematode in Texas.

E. O. Olsen is currently studying _Phytophthora_ foot rot and other diseases of citrus nursery stock.

Important tomato-growing districts exist in several parts of the State, and for more than a decade the Agricultural Experiment Station has maintained two field laboratories devoted to research on diseases of the crop. One of these is operated by P. A. Young at Jacksonville and the other is under the direction of A. L. Harrison at Yoakum. Although the work of the two laboratories is marked by close liaison on problems of common interest, such as southern blight, _Fusarium_ wilt, nematode root knot, and early blight, each is active in attacking purely local troubles. For example, during the past two years Dr. Young has experienced serious outbreaks of late blight in tomatoes in the vicinity of Jacksonville, while this disease has not occurred at Yoakum. Dr. Harrison's chief current interest is in producing strains of tomatoes resistant to _Fusarium_ wilt, root knot, and the collar rot phase of early blight. He has developed inoculation methods that are particularly effective for the purpose.

Efforts to control scab and other diseases of pecan by means of copper sprays have been associated frequently with markedly increased aphid populations. Work was begun in 1949 by D. W. Rosberg to examine more closely the relationship between disease control and insect infestation in this case. The problem is complicated by a variety of factors, such as coverage problems in spraying large trees, great differences in scab susceptibility among host varieties, etc. The first complete season's results have, however, suggested the possibility of successful formulation of combined fungicides for future trials. Dr. Rosberg is studying also diseases of onions in storage in an effort to develop means of lengthening the marketing period.

The most important disease of spinach in southwest Texas is white rust (_Albugo occidentalis_). Efforts to develop practical control measures were made from 1937 to 1945 by S. S. Ivanoff and continued in 1946 by T. J. Nugent. Since 1948 O. H. Calvert has been experimenting with inoculation procedures for use in selecting for resistance and with altered crop management to permit the use of fungicides.

Commercial production of Spanish-type peanuts, which has become an important and highly organized activity in the State during the past decade, is hampered in most years by serious losses due to southern blight (_Sclerotium rolfsii_). In 1940 and 1941 Glenn KenKnight, working at Stockdale, grew a large number of peanut strains in heavily infested soils, seeking differences in susceptibility to the disease. Such differences were observed. One of the least susceptible types was forwarded to B. C. Langley at Stephenville, who continued to work with the material until it was ready for release in 1948 under the name Spantex. B. C. Langley, A. L. Harrison, and G. M. Watkins are continuing the testing of new peanut seed lots for disease resistance and also are studying effects of certain cultural practices on losses inflicted by Sclerotium rolfsii.

From 1943 to 1945 the nation-wide Emergency Plant Disease Prevention Program was represented in Texas by G. E. Altstatt, S. M. Pady, H. W. Larsh, R. D. Watson, and G. M. Watkins. These men, none of whom was stationed in the State for the entire period, traveled almost constantly through the various farming districts and reported weekly to the Plant Disease Survey on the occurrence of crop diseases.

Plant pathologists in Texas are convinced that they are not likely soon to exhaust the array of crop disease problems requiring scrutiny. Occasionally a serious disease is introduced from another region, such as occurred when internal cork appeared recently in sweetpotatoes in east Texas. Plant breeders sometimes unwittingly combine excellent resistance to one major disease with spectacular susceptibility to an erstwhile minor trouble, leading to such difficulties as Victoria blight of oats. The rise of crop production costs has tended to narrow profit margins in many cases, with the result that disease losses formerly appearing negligible now loom increasingly large in the eyes of the growers. An important shift of interest toward a new class of crops brings not only new hosts but new disease problems. Such a thing is taking place now in Texas, where there is much enthusiasm for increased acreage in forage grasses and legumes. Plant pathologists in the State are at present greatly stimulated by an increased public awareness of their work and professional functions and by growing demands for their services.

TEXAS A. & M. COLLEGE SYSTEM, JACKSONVILLE AND COLLEGE STATION, TEXAS

THE ROLE OF PLANT PATHOLOGY IN VIRGINIA AGRICULTURE

S. A. Wingard

What has plant pathology meant to agriculture in Virginia? This, to me, is a very pertinent question and one whose answer is long past due. Taking stock of one's scientific accomplishments is most important and very revealing, yet it is something that most of us are prone to neglect. It is my purpose in the statement that follows to review briefly the history of plant pathology in Virginia with the hope that it may at least partially answer the question propounded above.

Plant pathology in Virginia, in comparison with other States, had a fairly early origin, yet it was too late to save the pear industry in southeastern Virginia, which reached the boom stage in 1880 and was suddenly snuffed out by the ravages of fire blight. The Virginia growers attributed the disease to over-heated sap, or to a surcharge of the electric fluid, and hung horseshoes in their pear trees to ward it off, although T. J. Burrill had already (1878) advanced the theory that fire blight was caused by bacteria. His theory was substantiated by later work (1881) of his own and completely confirmed by the experiments of J. C. Arthur in 1885. Despite this noteworthy discovery, control measures were not forthcoming and what promised to be a great Virginia pear industry died in its infancy.

Captain John Smith in 1629 reported that the colonists at Jamestown were able to produce peaches, apples, pears, apricots, vines, figs, and other fruits in abundance, although spraying for disease control did not come into existence until about 1887 following Millardet's discovery in 1882 that lime and copper could control downy mildew of grape. By 1892 Bordeaux spraying of grapes was common among growers in eastern Virginia, especially in Albemarle County. This practice, however, came too late to save the grape industry in that region, an industry that had its origin with the founding of the Jamestown Colony.

In the early years, the grape industry failed because the wine from the native grapes was too strong and heady; later because the introduced European grapes were so very susceptible to mildew and black rot. Finally, suitable varieties were developed by crossing the European and native varieties, and Bordeaux mixture was available for disease control, but by that time (1895) competition from California had increased to the point of discouraging Virginia growers. Thus, the grape industry was lost to Virginia, for periodic attempts since then to revive it have all failed. Nevertheless, grapes are still grown on a small scale for commercial and home use. Research on grape-disease control has continued and an experiment station bulletin on grape diseases and insects was published by R. H. Hurt in 1942. More recently research has been conducted with the newer organic fungicides, such as ferric dimethyl dithiocarbamate.

Apple, pear, quince, plum, peach, cherry, apricot and nectarine were introduced into Virginia from Europe, mainly as seeds, and planted by each early settler in the James River area as soon as he had succeeded in making clearings in the wilderness. These fruits were reported by Captain John Smith as being produced in abundance by 1629. Fruit growing was made compulsory by an act of the Virginia Assembly in 1639, but it remained almost wholly for home use up to 1854. Prior to this time orchard fruits were consumed mainly in liquid form or fed to hogs.

The improvement in transportation facilities between 1835 and 1887 paved the way for the commercial fruit industry of the State. Between 1860 and 1887 large plantings of peaches and pears were made on the south bank of the James River, in Surry County. These orchards proved unprofitable because the pear trees blighted and the fruit of the peach trees was destroyed at harvest time by the disease now known as brown rot. Practically nothing was known about fungus diseases at that time. A Virginia fruit grower is reported to have said in 1871 that "Rotting of peaches is due to an excessive flow of sap. If the growth of the trees is checked, by allowing grass to grow under them, a good crop is secured."

The winter apple industry had its birth about 1865, being made possible by the building of railroads into the Piedmont, the Valley, and Southwest Virginia, between 1840 and 1850. Impetus to the foreign demand for the Albemarle Pippin was brought about in 1837 by Andrew Stephenson, of Albemarle County, then Minister to the Court of St. James. A winter supply of home grown apples was shipped to him in London and he presented several barrels of Albemarle Pippins to Queen Victoria. She was so delighted with the flavor that she called for more from the same source and thus began the special demand for the Albemarle Pippin, as contrasted with the Newtown Pippin grown in the North, which later meant so much to the growers in Piedmont Virginia. It was pointed out by the editor of the Southern Planter in 1846 that the best fruit crop Virginia farmers could raise was the apple, the Pippin and some of the other fall and winter varieties being recommended. In 1877 growers in Albemarle County were shipping Pippins direct to Liverpool, England.

From the statement above, it would appear that the apple industry in Piedmont and Tidewater Virginia around 1880 was destined for a long period of prosperity. This, however, did not prove to be the case. The scene of pomological activity immediately shifted to other sections of the State, and the introduction of the refrigerator car in 1887 made it possible for distant fruit growers to compete with local markets. Diseases such as scab, bitter rot, cedar rust, and fire blight were taking a heavy toll. S. W. Fletcher, in 1932, had the following to say regarding the early apple industry in Virginia:

"The outlook for fruit growing in 1887 was not bright. The times were out of joint. Numerous gatherings of farmers resolved to 'view with great alarm the great depression which now rests upon our agricultural interests.' Prices were low. A horde of insect and fungus pests fattened on the trees, and no means of controlling them were known. 'The chief business of Virginia fruit growers in these days', lamented one of the growers, 'is to try to cheer one another up.' The apple industry, especially, was in the dumps."

Thus the apple industry, like the grape, the pear, and the peach industries, which preceded it, had suddenly come face to face with definite limiting factors, chief among which were fungus diseases (especially bitter rot) and insect pests. Hence, as a result of necessity, the fruit growers of Virginia turned to the sciences of plant pathology and entomology for relief. Fortunately for all concerned, the Virginia Agricultural and Mechanical College, now the Virginia Polytechnic Institute, had been chartered by the Assembly in 1872 and the Agricultural Experiment Station was established in 1888, thus making it possible for science to enter the field of fruit growing in Virginia.

It now seems nothing short of an act of Providence that William B. Alwood was appointed horticulturist and entomologist of the newly organized agricultural experiment station at Blacksburg in 1888, for it is to him, more than to any other, that the Virginia Fruit industry is indebted for its survival. To quote Fletcher again: "He stimulated and guided it while it was weak and despondent, devised and enforced laws for its protection, organized the State Horticultural Society, and showed qualities of leadership in many other directions which fruit growers are not likely to forget."

Dr. Alwood lost no time in developing the practice of spraying to help save the fruit industry. The first printed use of the term "spraying" in Virginia was in 1888, and was an account of experiments in Illinois in which Paris green was applied with a force pump to control codling moth. Bordeaux was used by Oscar Rierson of Glendover, Virginia, in 1887, for the control of grape rot. His results were not very favorable but others were more successful, and by 1892 Bordeaux spraying was common among grape growers, especially in Albemarle County. In 1889 Alwood contributed an article to the Southern Planter on "Apple Rusts", chiefly the cedar apple rust, and another on "Implements for Applying Insecticides and Fungicides," This, according to S. W. Fletcher, was the first scientific discussion of fungus diseases of fruit in Virginia.

The first crop pest law of Virginia, on peach yellows, was prepared by Alwood, and passed by the General Assembly in 1889. Without this foresight, peach yellows would probably have destroyed the peach industry. In 1892 he published the first full spray program for orchards in Virginia. The first spray calendar for disease and insects control was published two years later. Spraying with Bordeaux mixture saved the apple industry of Piedmont, Virginia, which at that time consisted chiefly of the Albemarle Pippin variety.

Alwood was a tireless worker and a prolific worker. He was working and publishing simultaneously in the fields of horticulture, entomology and plant pathology, yet his publications were of exceptionally high caliber and are so regarded even today. His publications on plant diseases had a momentous influence on the fruit industry of Virginia.

The Virginia fruit industry was indeed fortunate, after the retirement of Alwood to private life, to have his work in plant pathology continued by such able scientists as Howard S. Reed, E. B. Fred, J. S. Cooley, C. H. Crabill, H. E. Thomas, T. J. Murray, F. D. Fromme, and more recently by F. J. Schneiderhan, R. H. Hurt, and A. B. Groves. Virginia growers are fortunate also in being in close proximity to workers in the U. S. Department of Agriculture. W. M. Scott, C. L. Shear, M. B. Waite, Erwin F. Smith, Charles Brooks, D. F. Fisher, John W. Roberts and J. S. Cooley, of the Bureau of Plant Industry, deserve special mention for their contributions on the solution of fruit-disease problems in Virginia.

Many important fruit-disease bulletins have been published by research workers in Virginia who followed Alwood. In addition to these publications, members of the Experiment Station staff have published many timely articles on fruit-disease control in the "Southern Planter", "Virginia Fruit", and other agricultural magazines, as well as having presented papers before the State Horticultural Society and the American Phytopathological Society.

Research on fruit diseases and insects in Virginia has returned big dividends and the fruit industry of the State today owes its successful existence largely to the application of results of such work. Studies on cedar rust of apple resulted in the passage of the Cedar Rust Law by the

General Assembly in 1914, which enabled the fruit growers to eradicate red cedar trees in the vicinity of their apple orchards and thus control the destructive cedar rust disease. The commercial apple industry of the State, consisting primarily of plantings of rust-susceptible varieties, such as York, Rome Beauty, and Jonathan, would undoubtedly have been ruined had not this law been passed. Studies on other diseases and on spray materials for their control have resulted in the finding of practical methods for the control of most of these diseases.

Research plant pathologists are stationed at field laboratories in the major fruit-growing districts to study diseases and their control. Information thus obtained is passed on to the growers direct and through station bulletins, as well as through the bulletin "Information for Virginia Fruit Growers" which is revised annually; also, through the Spray Service of the Virginia Agricultural Extension Division, whereby each grower is not only notified when to spray but also what materials to use in each spray application.

It is of interest to note that in 1923 R. H. Hurt was employed by the Experiment Station and sent to Crozet to make a special study of fruit diseases in that section. He has continued to work in that section ever since and his research has been a major factor in the success of fruit growing in Piedmont Virginia. The fruit growers in the Piedmont section in 1930 expressed their appreciation for this work by donating $2,500 toward the construction of a laboratory building. The General Assembly then appropriated additional funds for its construction and equipment. The University of Virginia cooperated in the project by granting permission for the laboratory to be located on its grounds. This laboratory was maintained by the Virginia Agricultural Experiment Station for work in plant pathology and entomology until recently, when a modern laboratory building and a greenhouse, located near Charlottesville, were completed. R. H. Hurt is in charge of the research in plant pathology.

Fruit-disease research was begun at the Winchester Research Laboratory, Winchester, in 1922 by F. J. Schneiderhan who made many valuable contributions on apple scab, bitter rot, Missouri blotch, Xylaria root rot, and walnut toxicity. He was followed in 1929 by A. B. Groves who is still in charge of the fruit-disease research at that station. New buildings are now being constructed at the Winchester field station. A. B. Groves has made contributions on apple scab, sooty blotch, bitter rot, Xylaria root rot, measles, scald, cedar rust, fire blight, peach leaf curl, cherry leaf spot, sulfur fungicides, copper fungicides, new organic chemical fungicides, spray injury, and compatibilities of fungicides and insecticides on apples and cherries. His research at present includes long-time experiments on Xylaria root rot of apple, the evaluation of new fungicides and insecticides on apple scab, cedar rust, sooty blotch, peach curl, and the compatibility of new fungicides and insecticides.

Disease research has not been limited to fruit crops. Much attention has been devoted to research on the diseases of tobacco, peanuts, small grains, beans, tomatoes, cabbage, spinach, and other truck crops. Work is now underway on the diseases of apples, peaches, cherries, tobacco, tomatoes, beans, grapes, raspberries, small grains, corn, alfalfa, red clover, peanuts, soybeans, and other crops.

Tobacco has been a major money crop in Virginia since the colonists first settled at Jamestown. Tobacco in those days paid taxes to the mother country, and two hundred pounds of tobacco paid the fare of an English lass, who later became the wife of a pioneer bachelor. Tobacco is troubled with many diseases: leaf spots, mosaic, ring spot, Granville wilt, blue mold (downy mildew) sore shin, southern blight, root rot, and, more recently, the most destructive of all, black shank. These diseases have commanded the attention of research workers for many years. Investigators of the Experiment Station at Blacksburg, the several branch experiment stations, and the U. S. Department of Agriculture have made valuable contributions in the solution of these tobacco-disease problems.

Two bacterial diseases of tobacco, wildfire and angular leaf spot, appeared in Virginia in 1918 and caused very severe losses for several years. F. D. Fromme, S. A. Wingard, and T. J. Murray did pioneer work on these diseases and they were eventually brought under control. Ring spot of tobacco received attention from F. D. Fromme, S. A. Wingard, C. N. Priode, and R. G. Henderson. Tobacco mosaic and black root rot have been a special project of R. G. Henderson for several years. He has succeeded in developing good commercial varieties of tobacco of different types with resistance to these diseases. Blue mold of tobacco appeared in Virginia in 1932 and for several years caused great damage to tobacco seedlings in plant beds. Pioneer work on this disease by J. A. Pinckard and R. G. Henderson in cooperation with workers in the U. S. Department of Agriculture, Duke University, and other State experiment stations resulted in practical control measures. G. M. Shear made valuable contributions on the physiological diseases of tobacco commonly known as frenching and mature leaf breakdown.

A tobacco disease research station was established at Chatham in 1936 with J. A. Pinckard in charge. He studied tobacco mosaic, black root rot and blue mold and made contributions on all three diseases. He was followed in 1941 by W. A. Jenkins, who has devoted the greater part of his time to studies on meadow nematode and black shank of tobacco on which he has made invaluable contributions. Black shank appeared in Virginia in 1937 and spread rapidly over the State. Many farms were rendered unfit for tobacco production by black shank infestation until Jenkins developed good resistant varieties which are now being grown on thousands of acres in Virginia and North Carolina. New strains of tobacco with combined resistance to black shank, Granville wilt, mosaic and root rot are now being developed.

A 78-acre farm near Chatham was purchased by the State in 1948 for growing seed of the black shank-resistant varieties for commercial use, and for tobacco disease research, especially the breeding of disease-resistant varieties. W. A. Jenkins is in charge of the disease research and J. L. LaPrade of the seed production. Cooperative work is being done on the development of black shank-resistant burley tobacco varieties with workers in Kentucky and Tennessee.

Prior to 1947 research in Virginia on the diseases of corn and small grains was limited to minor work by Fromme, Wingard, and Shear on the stalk and ear rots of corn, nutritional diseases and seed treatment of corn, seed treatment of small grains, nematode and black stem rust of wheat, and breeding for loose smut-resistant varieties of wheat. Beginning in 1947 Curtis W. Roane has devoted full time to research on the diseases of corn and small grains and G. M. Shear has continued his studies on some of the deficiency diseases.

Roane is working cooperatively with the plant breeders in the Agronomy Department of this experiment station and the U. S. Department of Agriculture in an effort to develop disease-resistant varieties of small grains and corn hybrids. The corn diseases receiving major emphasis are the leaf blights (*Helminthosporium turcicum*, *H. maydis*, and *H. carbonum*), and stalk rots (*Gibberella fujikuroi*, *G. zeae*, and *Diplodia zeae*). An attempt is being made to develop barley with resistance to leaf rust, loose smut and powdery mildew; oats with resistance to crown rust, Victoria blight, loose smut and stem rust; and wheat with resistance to leaf and stem rust, powdery mildew and loose smut.

R. G. Henderson, in cooperation with T. J. Smith and others, is attempting to develop disease-resistant strains of alfalfa adapted to Virginia conditions. Diseases caused by the following organisms are receiving major consideration: *Sclerotinia trifoliorum*, *Corynebacterium insidiosum*, *Ascochyta imperfecta*, *Colletotrichum trifolii*, *Pseudopeziza medicaginis*, *Stemphylium botryosum*, *Stagonospora meliloti*, *Rhizoctonia* sp., and *Ditylenchus dipsaci*. Stem nematode was discovered in Virginia for the first time in 1948 near Richmond and is apparently still restricted to that one location. The infested area has been taken over for experimental work. Several of Oliver F. Smith's nematode-resistant strains of alfalfa are being tested on this area and some of them show considerable promise.

Research on peanuts by L. I. Miller , S. A. Wingard and E. T. Batten has dealt primarily with chemical seed treatment, sulfur and copper dusting for leaf spot control, and *Sclerotium* wilt. Seed treatment has greatly improved the stand of plants and enabled the peanut growers to use machine-shelled seed, which means a great saving over hand-shelled seed. At least 99 percent of the growers now practice seed treatment. Sulfur dusting for leaf spot control is generally practiced and it has greatly increased the yield and quality of both hay and nuts.

G. M. Shear and L. I. Miller have made some valuable contributions on manganese deficiency and overliming of peanuts. They are continuing their studies on these and other nutritional problems of peanuts.

Work on the diseases of vegetable crops has been conducted both at the Virginia Agricultural Experiment Station, Blacksburg, and the Virginia Truck Experiment Station, Norfolk. The work at Blacksburg has dealt with studies by Fromme on the development of cabbage resistant to yellows, studies on bean and cowpea rusts by Fromme and Wingard, the development of rust-resistant varieties of snap beans by Wingard, experiments on club root of cabbage by H. S. Reed, yeast-spot of lima bean by Wingard, bacterial soft rot of tomato by Wingard and Massey, and the control of the leaf blights and fruit rots of tomatoes by Reed, Thomas, Fromme, Wingard, and Henderson.

The region around Norfolk has long been noted for its fine truck crops, an industry that owes its present existence to research conducted in plant pathology, horticulture, and entomology by the Virginia Truck Experiment Station. The establishment of the Truck Experiment Station was made possible by the Southern Produce Company, a cooperative vegetable marketing and shipping organization, which in 1907 donated 57 acres of land for a truck experiment station and also provided the necessary buildings and equipment. From 1907 to 1920, funds for operation were furnished from the fertilizer sales tax fund of the State Department of Agriculture at Richmond and by the sale of produce at the Truck Station. In 1920 the Virginia Truck Experiment Station was established as a permanent State institution by an Act of the General Assembly and given adequate financial support. The research staff has been greatly increased in recent years and subsequent purchases and leases of land have expanded the experimental area.

During the early days of the Truck Experiment Station, the pathological work was handled by L. L. Harter of the U. S. Department of Agriculture, who devoted most of his attention to certain malnutrition diseases of truck crops, especially of cabbage and spinach. He made important contributions on the solution of these problems. During this period T. C. Johnson, then director, also contributed several publications on potato diseases.

The discovery of the true nature of spinach blight (mosaic) by J. A. McClintock and L. B. Smith and the development of the resistant variety, Virginia Savoy, by McClintock, Smith and H. H. Zimmerley and the resistant variety, Old Dominion, by Zimmerley were contributions of great importance in our knowledge of virus diseases and the control of diseases by the breeding of resistant varieties. This work undoubtedly saved Norfolk as a spinach growing area.

From 1920 to 1924, Zimmerley, F. W. Geise, Herbert Spencer and R. J. Davis made important contributions on the dusting and spraying of various truck crops for the control of insects and diseases. F. P. McWhorter made important contributions on the treatment of beet seed for the control of seedling diseases and on the Fusarium wilt and early blight diseases of tomatoes. He also cooperated with the U. S. Department of Agriculture in investigations on the diseases of certain ornamentals, especially of narcissus and poppy.

In 1931 and 1932, Harold T. Cook published the first extensive papers on the powdery mildew disease of snap beans and methods of control. He also published extensively on vegetable seed treatment. This research showed that treating spinach seed with red copper oxide would insure a satisfactory stand of spinach, whereas formerly the growers had had much difficulty in obtaining satisfactory stands. Later experiments showed that as good results could be obtained by treating with zinc oxide, which costs less and is less irritating to the respiratory passages of the operators. The annual saving in cost of treating spinach seed by substituting zinc oxide for red copper oxide is considerable for the Norfolk area alone. The gain in crop value from treating spinach seed often amounts to more than $100 an acre, while the cost of treating the seed is only about 15 cents an acre. In the Norfolk area it has now become a regular practice for the seedsmen to treat all spinach seed for the growers at about cost.

Investigations by Cook also resulted in finding a wilt-resistant variety of watermelon, the Hawkesburg, which is similar in shape and color to the Owens Grey variety commonly grown in the Smithfield area where the wilt disease made it unprofitable to grow the ordinary varieties on many of the farms. Cook and Nugent investigated the effect of acid-forming and non-acid forming fertilizers on the development of potato scab and obtained evidence that the disease was influenced only to the extent that the fertilizers changed the soil reaction. This reassured the farmers that it was safe to use the more desirable non-acid forming fertilizers as long as the soil reaction was kept in the neighborhood of pH 4.8 which was unfavorable for scab development.

In 1940 Cook and Nugent published a manual entitled "The Control of Truck Crop Diseases in Tidewater Virginia". This manual was written in a new style in which the control measures were given for the disease of the crop as a whole rather than for individual diseases. This arrangement made the manual much more practical for the use of county agents, agricultural teachers, and farmers. A publication was prepared by Cook and Harter on the results of tests of new fungicides for treating seed sweetpotatoes to meet the new emergency brought about by the wartime scarcity of the fungicides formerly used for that purpose. Some of the substitutes discovered in these investigations have become permanent because they are more desirable in a number of ways than the materials formerly used. The vegetable disease research at the Virginia Truck Experiment Station is now in the hands of R. S. Mullin and T. J. Nugent.

The work in plant pathology at the Virginia Ploytechnic Institute, as pointed out above, was begun in 1888 by William B. Alwood, then horticulturist and entomologist, of the experiment station. A Department of Bacteriology and Plant Pathology was organized in 1908 with the late Howard S. Reed as head. Reed was succeeded by F. D. Fromme in 1916, and he in turn by S. A. Wingard in 1928. Botany was transferred in 1922 from the Department of Botany and Zoology to the Department of Bacteriology and Plant Pathology and the name of the latter changed to Department of Botany and Plant Pathology. In 1935 the Department of Botany and Plant Pathology was combined with the Department of Entomology and the Department of Zoology and Animal Pathology to form the Biology Department. On September 1, 1949, plant pathology and physiology were separated from the Biology Department and set up as a Department of Plant Pathology and Physiology with S. A. Wingard again as head.

At present there are six men in the department (A. B. Groves, R. H. Hurt, W. A. Jenkins, L. I. Miller, J. L. LaPrade, and Luben Spasoff) who devote full time to research in plant pathology and five (S. A. Wingard, R. G. Henderson, G. M. Shear, C. W. Roane, and J. I.

Shafer, Jr.) who divide their time between research and teaching in plant pathology and physiology. S. B. Fenne and J. M. Amos handle the extension work in plant pathology.

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PLANT PATHOLOGY IN THE STATE OF WASHINGTON, -- PAST, PRESENT, FUTURE

George W. Fischer[1]

INTRODUCTION

Washington is a large and climatically diverse State. East of the Cascade Range the average annual precipitation varies from seven inches in the central part of the State to nineteen in the eastern; west of the Cascades, from forty to one hundred and twenty inches. In eastern Washington dry land farming predominates, with wheat (and to a lesser extent other cereals), dry edible peas, alfalfa, and other forage crops forming the major crops. The intense bright sunshine in the central part of the State makes this region especially adapted to the production of quality tree fruits for which Washington is so well-known. These tree fruits are dependent on irrigation, as are in fact the great variety of vegetable and field crops for which the area is also acquiring a reputation. West of the Cascade Range, agriculture, is similarly diversified to include strawberries, bramble fruits, tree fruits, ornamental bulbs, cranberries, blueberries, walnuts, filberts, peppermint, cereals, potatoes, squash, cabbage, beets, snap beans, sweet corn, and other vegetables, vegetable seed production, and abundant pasture land, besides the vast forested areas for which the State is indeed well-known. In western Washington and to a lesser extent in parts of eastern Washington are the extensive evergreen forests which give Washington its name, "The Evergreen State." Since the diversity of the climate and topography of the State have given rise to such diversity of crops, it can readily be appreciated that there must follow a diversity also of production problems. Plant diseases have been prominent among these, and have provided a perpetual challenge to the plant pathologists and to the plant breeders as well.

HISTORICAL ACCOUNT 1892-1950

The early development of plant pathology in the State of Washington is inextricably woven around the life and activities of one outstanding plant pathologist, -- F. D. Heald. Before Dr. Heald's advent to the State College of Washington, there was no such thing in that institution as a Department of Plant Pathology. The State College of Washington was established in 1890, and for many years Botany, Zoology (including Entomology), and Bacteriology were combined into one department. For the first few years C. V. Piper was professor of the Department and apparently its sole member. In the Experiment Station Staff of six, Piper was also "Botanist and Entomologist." Professor Piper, in the 1893 annual report of the Experiment Station, said that the great prevalance of wheat smut is the most important production factor and "all is due to carelessness in treating seed."

The nearest approach to a course in plant pathology came in 1893 with a course in "Cryptogamic Botany." The description given in the Third Annual Catalogue (1893-94) describes this course as follows: "An introduction to the morphology and classification of fungi. Special attention will be given to economic forms, the means of controlling them, and methods of tracing life histories. Two days in the week throughout the year." Professor Piper complained that, owing to the press of college duties, he could not give adequate attention to the many problems of plant diseases and insect pests. Specifically mentioned, besides the all-important wheat bunt, were peach mildew, peach leaf curl, mildews of many crops, tomato blight (now known as curly top), crown gall of grape and apple (the latter widespread in eastern Washington). Orange rust of raspberry was introduced into Washington in 1895 and Professor Piper recorded an attempt to eradicate this disease. (Apparently the attempt was unsuccessful, or the disease was reintroduced later, because orange rust is commonly found in western Washington.) From this embryonic beginning, we can trace the development of plant pathology through the succeeding years.

In 1896, R. W. Doane was appointed to the Department of Botany, Zoology, and Bacteriology, and a course in "Systematic Botany" was added to the curriculum. The catalogue for that year stated that for the latter course "The fungi and bacteria receive most attention during the first semester."

In 1902, when the 11th Annual Catalogue was issued, C. V. Piper was still listed as Professor, but with added staff members as follows: Robert E. Snodgrass, Assistant Professor of Entomology; R. Kent Beattie, Instructor in Botany, and Assistant Botanist in the experiment station; and Herbert S. Davis, Instructor in Zoology. Two plant pathologsist were temporarily stationed at the Western Washington Experiment Station at Puyallup: David A. Brodie (Superintendent), and Wm. H. Lawrence. Brodie worked on potato late blight control and Lawrence on blackberry crown gall, among many other problems.

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[1] The author gratefully acknowledges the help of several of his colleagues in checking the manuscript, and furnishing suggestions for improvement.

In 1903, C. V. Piper resigned to take a position with the U. S. Department of Agriculture, and in the 1904 W.S.C. catalogue, R. Kent Beattie was listed as "Acting Professor of Botany." A. L. Melander was added as "Instructor in Entomology." In the 1903 Experiment Station Annual Report, Professor Piper indicated that root rots of orchard trees continued to be bad in Clark County. The cause was determined as Armillaria mellea. This was described in popular Bulletin No. 59 "Root diseases of fruit and other trees caused by toadstools", by C. V. Piper. It was further recorded in the 1903 Experiment Station Annual Report that in spite of the general use of blue vitriol, very large annual losses continued due to smut diseases of grain. In the same year an attempt apparently was made to control the Mormon cricket by use of "The South African Grasshopper Fungus." The attempt was totally ineffective.

In 1904 William H. Lawrence apparently completed his assignment at Puyallup and was returned to the Pullman Station as "Assistant in Botanical Investigations." In the 1904 Annual Experiment Station Report, Professor Piper stated that tremendous losses were being suffered due to smut in wheat and oats and to threshing machine explosions, resulting from threshing very smutty grain. The incidence of wheat smut ran as high as 40 percent in single fields.

In 1905, two new courses in instruction were added:

"3. Morphology and Classification of Fungi" (the old course in Cryptogamic Botany).
"9. Economic Fungi."

The course description for "Economic Fungi" as given in the 1905 catalogue was as follows:

" A study of the more common plant diseases due to fungi; their distribution, the life histories of the parasites; culture methods and methods of combatting them. Two lectures and 6 hours laboratory per week, first semester, Mr. Lawrence."

This new course is, as far as I can determine, the first bona fide course in plant pathology although it is not called by that name. William H. Lawrence was the instructor.

In 1907, Zoology was removed to become an independent Department, leaving a Department of Botany and Bacteriology of which R. Kent Beattie was professor, and William H. Lawrence and Samuel W. Collett instructors.

In 1908, William H. Lawrence resigned to take charge of the newly created Western Washington Experiment Station at Puyallup and also to serve as Plant Pathologist at that Station. Apparently this was the first instance where an experiment station man in the State of Washington received the title of Plant Pathologist or any subrank thereof. In 1909, a now very familar name appeared in the College catalogue, -- Harry B. Humphrey, as Assistant Professor. The course "Fungi" was split into two five-hour sequence courses while the course "Economic Fungi" was unchanged. All three courses were taught by Professor Humphrey. Another now well-known botanist and plant pathologist was added to the staff in 1909 with the appointment of N. Rex Hunt.

In 1911 came the first designation in the State College of Washington of any professorial rank in plant pathology, when H. B. Humphrey was listed as "Professor of Plant Pathology." Dr. Humphrey taught courses in Fungi, Cytology, Algae, Ecology, Histology, Bacteriology, and Marine Algae in addition to helping with one other course. It would appear that Dr. Humphrey was a busy man in those days. Also in 1911 William H. Lawrence resigned and was replaced by another plant pathologist who has since become well-known in his field -- H. P. Barss.

The department of Botany in the Experiment Station was abolished in 1911 and in its stead there was established a Department of Plant Pathology in the Experiment Station, with H. B. Humphrey as Plant Pathologist in charge.

What is possibly the nucleus of the eventual segregation of Plant Pathology from its mother science, Botany, came about in 1912 when the Botany courses were divided among sections: Morphology and General Botany; Physiology and Ecology; Pathology; Technical Courses. Under "Pathology" we find 4 new or newly designated courses:

"51. General Plant Pathology. 3 hours. Introductory Course.
"52. Plant Pathology. 3 hours. Morphology and Systematics of Pathogenic Bacteria, Slime molds, and Phycomycetes.
"53. Plant Pathology. 4 hours. Continuation of 52 to include Ascomycetes, Basidiomycetes, and Fungi Imperfecti.
"54. Forest Fungi. 2 hours."

It is thus seen that by 1912, and probably largely through Professor Humphrey's influence, the instruction in Mycology and Plant Pathology had begun to take quite a definite form. It must be remembered that in addition to Professor Humphrey's teaching activities, he served as Plant Pathologist and Vice Director in the Experiment Station from 1910 to 1913. Further evidence of Professor Humphrey's successful activities is seen in the 1912 Agricultural Experiment Station Report with the statement "The Division of Plant Pathology is now fairly well-equipped as to laboratory facilities, microscopes, and other necessary apparatus; and it is now possible to push to completion one by one the several projects before us."

In 1912, H. P. Barss resigned to take a position with Oregon State College and Experiment Station, and H. B. Humphrey left in 1913 to head up the pathology activities of the Office of Cereal Investigations in the Bureau of Plant Industry at Washington, D. C. He was succeeded by Ira D. Cardiff as "Professor and Head of the Department and Plant Physiologist in the Experiment Station." In the same year another reorganization took place, probably as a result of the change in headship. The Division of Plant Pathology was abolished and in its stead was organized a Division of Botany in the Experiment Station, with Cardiff as head. John G. Hall was added to the staff as "Professor of Plant Pathology and Plant Pathologist in the Experiment Station," and D. C. George as "Instructor and Assistant Plant Pathologist." This it is seen that by 1914 there had been established a definite concept of dual responsibility in teaching and research vested in the same individual rather than assigned to separate individuals.

In 1913 the United States Department of Agriculture established a field laboratory and station at Wenatchee in support of investigations of tree-fruit crops in that area. Pathological investigations were conducted by D. F. Fisher. Fisher was active in investigations of storage decays, apple mildew, and other fruit diseases.

In 1914, H. M. Woolman was added as "Assistant in Plant Pathology." This latter title is equivalent to the present rank of "Junior Plant Pathologist."

In 1915, there arrived the man who was to have more influence on the welfare of the Department that any other person. F. D. Heald was appointed as "Professor of Plant Pathology and Plant Pathologist in the Experiment Station." He succeeded Hall, who resigned. In the same year, two new courses of instruction were added:

"Botany 55: Diseases of Fruits.
"Botany 56: Methods in Plant Pathology."

The roster of courses in Plant Pathology was expanded during the following two years, and in the 1917 catalogue under the section "Plant Pathology" of the Department of Botany and Bacteriology, there were listed:

"P. P. 1. General Pathology; 5 hours.
P. P. 2. Crop Diseases; 3 hours.
P. P. 11. Fungi of Plant Disease; 3 hours.
P. P. 12. Methods in Plant Pathology; 3 hours.
P. P. 13. Principles and Practices of Disease Control; 3 hours.
P. P. 16. Forest Pathology; 2 hours.
P. P. 19. Diseases of Fruits; 3 hours.
P. P. 21. Diseases of Cereal and Forage Crops; 2 hours.
P. P. 40. Problems in Plant Pathology.
P. P. 41. Research in Plant Pathology."

The 1917 catalogue indicated that all these courses were taught by Dr. Heald. At the same time he was Plant Pathologist in the Experiment Station. Doubt our story if you can, but F. D. Heald was a busy man. How any man could teach all these courses and serve the demands involved as Plant Pathologist in the Experiment Station is something that is very hard for most of us today to comprehend. At the same time he gave tremendous impetus to the investigations of wheat smut.

The year 1918 was outstanding in the history of the Department of Plant Pathology at the State College of Washington, because it was in that year that the department itself was elevated to a full-fledged independent Department of Plant Pathology. At the same time the research Division of Plant Pathology was re-established in the Experiment Station. In the 1918 catalogue, we find for the first time a "College of Agriculture." Dr. F. D. Heald was head of the newly created Department of Plant Pathology in the College of Agriculture and of the Division of Plant Pathology in the Experiment Station, which position he retained until his retirement in 1941.

Also the year 1918 saw the advent of the first Extension Plant Pathologist in the State of Washington, in the person of A. M. Christensen. He stayed but a short time and was succeeded by Noel F. Thompson, who also soon left and was promptly succeeded by George L. Zundel. Judging from the available records, all these changes took place during the year 1918.

Also in 1918, B. F. Dana was added to the staff of the department of Plant Pathology as Instructor and Assistant Plant Pathologist to replace Woolman, who resigned to accept a position with the Office of Cereal Investigations, Bureau of Plant Industry. Of interest now is the record in the 1918 Experiment Station Annual Report of the first report from the State of Washington of the aecial stage of stem rust on the common barberry.

In 1919 two new courses were offered in Plant Pathology. They were "P. P. 15, Diseases of Truck Crops", and "P. P. 42, Seminar." In the same year, Edward C. Johnson, a Cereal Pathologist in his own right with the U. S. Department of Agriculture, assumed his duties as Dean of the College of Agriculture and Director of the Agricultural Experiment Station. In 1923 D. J. Crowley was appointed in charge of the cranberry laboratory at Long Beach to conduct investigations on diseases and insects of cranberries in that region.

No further changes in staff or instruction took place until 1925 when E. E. Honey was added to the staff as Instructor in Plant Pathology. Apparently Dr. Honey was a young, unusually enthusiastic collector, not just for pathological and mycological items but for many other things of interest to him as evidenced by a record which Dr. Heald left in his office and which is typical of the latter's wit: "Bees collect honey but Honey collects".

The year 1926 is another landmark in the history of the Department for it was in that year that Dr. Heald's "Manual of Plant Diseases" was published. The place that this book found in the science of Plant Pathology all over the world is well-known and needs no elaboration here. Also in 1926, Dr. Zundel resigned as Extension Assistant Professor in Plant Pathology to go to the Connecticut Experiment Station to work with G. P. Clinton.

In 1926 Honey resigned to take a position with the New York State Extension Service. He was replaced by George D. Ruehle as Assistant in Plant Pathology. In the same year the courses of instruction were renumbered so that they appeared in the catalogue as follows:

"P. P. 101	General Pathology
P. P. 110	Fungi of Plant Disease
P. P. 111	Fungi of Plant Disease (2nd Sem.)
P. P. 112	Methods in Plant Pathology
P. P. 113	Principles and Practices of Disease Control
P. P. 115	Diseases of Truck Crops
P. P. 116	Forest Pathology
P. P. 119	Diseases of Fruits
P. P. 121	Diseases of Cereal and Forage Crops
P. P. 140	Problems in Plant Pathology
P. P. 142	Seminar
P. P. 241	Research in Plant Pathology"

Several of these courses were offered in alternate years only.

Plant Pathology in the western part of the State received some support in 1927 with the appointment of G. A. Newton as Plant Pathologist at the Western Washington Experiment Station at Puyallup.

In 1927, Dana resigned to accept appointment as plant pathologist at the Texas Agricultural Experiment Station. He was replaced by Lee E. Miles as Assistant Professor of Plant Pathology Also in 1927, E. L. Reeves was appointed by the U. S. Bureau of Plant Industry as Field Assistant in the Division of Fruit and Vegetable Crops and Diseases and stationed at Wenatchee to work on diseases of tree fruits.

Miles resigned in 1928 and was succeeded by Leon K. Jones as Assistant Professor and Assistant Plant Pathologist in the Experiment Station. H. H. Flor was added to the staff as Associate Pathologist, U. S. Department of Agriculture, to work with Dr. Heald on the wheat smut problem. He was the first Federal Plant Pathologist to be appointed to the Washington Agricultural Experiment Station.

In 1930, the first doctorate in Plant Pathology was awarded. The recipient of this honor was George D. Ruehle. Incidentally, this was the first doctorate to be awarded from the entire institution. Following his graduation in 1930, Ruehle resigned his position as Assistant in Plant Pathology to accept appointment with the Citrus Experiment Station in Florida. In 1930, three courses were added to the Plant Pathology curriculum: "P. P. 210 and 211, Advanced Mycology" and "P. P. 117, Diseases of Ornamentals." Also in 1930, W. D. Courtney was appointed by the U. S. Bureau of Plant Industry as Junior Nematologist at the Western Washington Agricultural Experiment Station to begin investigations of nematode troubles in Washington and Oregon.

In 1931, C. S. Holton was added to the staff as agent, U. S. Department of Agriculture, to replace Dr. Flor who was transferred to Fargo, North Dakota.

No further changes took place until 1932 when Glen A. Huber was added to the staff as "Instructor and Assistant in Plant Pathology." Huber taught the beginning Mycology courses (P. P. 110 and 111), Methods in Plant Pathology (P. P. 112), and with Jones, General Plant Pathology (P. P. 101). Also in 1932 the second edition of Heald's Manual appeared.

In 1934, Dr. Huber resigned to take a position as Plant Pathologist at the Western Washington Experiment Station in Puyallup. He was replaced by George W. Fischer as half-time Instructor in Plant Pathology, teaching the two Mycology courses, the methods course, Forest Pathology, and the beginning course with Jones, and the Advanced Mycology course with Heald.

To further augment plant disease investigations in western Washington Leo Campbell was assigned in 1935 to work on vegetable diseases in the northwest corner of the State. He was principally concerned with diseases of beans and beets, but at the same time included other vegetables and also began a period of investigations on strawberry diseases which was to continue for many years.

In 1936, Fischer resigned to accept appointment with the U. S. Bureau of Plant Industry to work on diseases of forage grasses. His headquarters remained at Pullman. W. Harley English was appointed as half-time Instructor in Plant Pathology to replace Fischer.

In 1937, Professor Heald was granted a year's leave of absence and was gone from the Department from July 1937 until June 1938. S. M. Dietz was imported from Iowa State College to serve as Acting Head of the Department. Dr. Campbell was transferred to the Western Washington Experiment Station as Assistant Plant Pathologist.

Plant Pathology work was first started at the Irrigation Experiment Station at Prosser when, in 1938, Richard Wellman was appointed to that Station as Junior Plant Pathologist. He left the following year to take a research position with Boyce Thompson Institute and was replaced by J. D. Menzies, who began a research program emphasizing the diseases of alfalfa and virus diseases of stone fruits, particularly in the Yakima Valley.

In 1939, English resigned to accept appointment with the U. S. Department of Agriculture at Wenatchee, to work on problems of decay of apples and pears in storage and in transit. D. M. Coe succeeded him as Instructor in Plant Pathology.

No further changes in personnel or instruction took place until 1941 when Heald was retired as Emeritus Professor. He was succeeded by J. G. Harrar as Professor and Head of the Department and Chairman of the Division of Plant Pathology in the Experiment Station. Also in 1941 C. J. Gould was appointed Assistant Plant Pathologist at the Western Washington Experiment Station to begin some badly needed investigations of diseases of ornamental crops, particularly bulbs.

Another important phase of the plant pathology program in the State of Washington was begun in 1942 with the establishment, by the State Department of Agriculture, of the Plant Introduction and Quarantine Station, at Moxee. D. M. Coe was the first plant pathologist in charge of the Station. He collaborated with Reeves in extensive surveys of stone fruit viruses in central Washington and in laying much of the ground work for the future functioning and importance of the Station.

In 1943, Harrar resigned to accept a position with the Rockefeller Foundation in Mexico. E. J. Anderson was appointed to succeed Harrar. Also in 1943 Folke Johnson was appointed at the Western Washington Experiment Station as Assistant Plant Pathologist to work on certain diseases of tree fruits and cane fruits.

In 1944, the Division of Fruit and Vegetable Crops and Diseases, U. S. Bureau of Plant Industry, appointed Glen Pound as Assistant Pathologist at the Northwest Washington Experiment Station at Mount Vernon, to work on the more important diseases affecting the vegetable seed crops in that area. L. K. Jones resigned to accept a position with the U. S. Bureau of Entomology and Plant Quarantine. In the same year, Washington became the 18th State to join the Federal Government in the campaign to eradicate barberry bushes. Mr. H. B. Busdicker was appointed as State leader and Plant Pathologist, U. S. Bureau of Entomology and Plant Quarantine.

In 1945, Anderson resigned to accept a position with the Pineapple Research Institute in Hawaii. Fischer resigned his position as Pathologist with the Division of Forage Crops and Diseases, U. S. Bureau of Plant Industry at Pullman, to accept appointment with the State College of Washington, replacing Anderson. Earlier in the same year S. B. Locke was added to the staff as Assistant Professor and Associate Plant Pathologist. Also in 1945, Menzies resigned his position with the Irrigation Experiment Station to accept appointment as Pathologist with the U. S. Department of Agriculture, Columbia Basin Investigations Project but maintained headquarters at the Prosser Station. This project was begun to furnish research information on the vast Columbia Basin Irrigation Project prior to the actual settlement of the area.

In 1946 several changes took place. George Nyland was added to the Plant Pathology staff as Instructor and Junior Pathologist in the Experiment Station. D. M. McLean was appointed as Associate Pathologist, U. S. Department of Agriculture, to succeed Glen Pound at the Mount Vernon Station. Dr. Pound had resigned earlier in the year to go with the University of Wisconsin. Frank V. Stevenson was appointed later in the same year as Assistant Professor of Plant Pathology and Assistant Pathologist in the Experiment Station. M. R. Harris was appointed as Extension Plant Pathologist; he was the first extension plant pathologist to be appointed since Dr. Zundel resigned in 1926. Finally, in 1946, an important step took place when E. C. Blodgett was appointed jointly with the Washington State Department of Agriculture as Associate Plant Pathologist to head up a program of research, survey and nursery stock improvement in the field of stone fruit viruses, and to supervise the work at the Plant Introduction and Quarantine Station at Moxee.

The year 1947 saw five additions to the staff in Plant Pathology. Early in the year Roderick Sprague was added as Associate Professor and Associate Plant Pathologist in the Experiment Station and R. C. Lindner was appointed as Associate Plant Pathologist at the Tree Fruit Experiment Station to work on the physiology and biochemistry of stone fruit viruses. C. M. Wright was appointed as Assistant Plant Pathologist, with the State Department of Agriculture. Charles Gardner Shaw was appointed as Instructor and Junior Plant Pathologist. A. E. Rich was added to the staff as Instructor in Plant Pathology and Assistant Plant Pathologist to replace Stevenson who resigned to accept a position with the California Polytechnic Institute.

In 1948, S. O. Graham was appointed by the State Department of Agriculture to assist in the nursery improvement program, with Blodgett. Nyland resigned to accept appointment with the University of California at Davis. C. M. Wright resigned his position with the State Department of Agriculture to succeed Nyland. H. C. Kirkpatrick was appointed by the U. S. Department of Agriculture to work at the Tree Fruit Experiment Station in the field of chemotherapy of stone fruit viruses, with Lindner.

The year 1950 saw four staff changes. Sprague transferred from Pullman to the Tree Fruit Experiment Station at Wenatchee to conduct work on powdery mildew of apples and other parasitic types of tree-fruit diseases and also to be closer to the research on snow mold and snow scald of wheat in adjacent Douglas County. J. P. Meiners was appointed at Assistant Professor and Assistant Plant Pathologist to succeed Dr. Sprague. In the same year T. O. Diener was appointed as Assistant Plant Pathologist and stationed at the Irrigation Experiment Station at Prosser to work in the field of stone-fruit viruses, and J. G. Barrat was stationed at the same place as Plant Pathologist and Entomologist, succeeding S. O. Graham who resigned to continue graduate work.

At the present time there are 26 full-time plant pathologists in the State of Washington. Ten of these are at Pullman and the remainder at the various field stations throughout the State. Seven of the plant pathologists at Pullman are on the teaching staff and most of those at the outlying stations are listed with the Graduate Faculty to give recognition to their services in the counselling and instruction of graduate students. At the present time there are twelve graduate students in the Department, ten of whom are candidates for the doctor's degree.

Alumni

The Department of Plant Pathology has graduated 46 students with the Bachelor's Degree from the period 1912 through 1950. Sixteen have been awarded the degree Master of Science from 1916 through 1941. Seventeen have been awarded the Doctorate during the period 1930 through 1950. The names of these alumni, the degrees received and the year in which they were awarded are appended below.

Bachelor of Science

D. C. George	(In Bot.)	1912	Roderick Sprague	1924
B. F. Dana	(In Bot.)	1916	George A. Newton	1925
Walter J. Bach		1921	G. A. Huber	1925
L. W. Boyle		1923	E. G. Davenport	1926
D. J. Crowley		1923	John Large	1926
Charles S. Parker		1923	Harry Elcock	1926
Geo. D. Ruehle		1923	Jess Kienholz	1928
Chas. F. Lackey		1924	K. F. Baker	1930
C. H. Spiegelberg		1924	Lindsay Loring	1931

Bachelor of Science (Cont.)

Earl J. Anderson	1932
Henry Carl Newbom	1933
Carl Robert Frees	1933
Otto F. Schnellhardt	1933
John A. Milbrath	1934
W. Harley English	1935
Richard H. Wellman	1935
Karl E. Baur	1936
Heston O. Weyrich	1936
D. M. Coe	1937
Carl K. Riesenweber	1938
S. I. Cohen	1939
John R. Hardison	1939
William E. Rader	1940
Elwood Fryer	1940
George Nyland	1940
Edwin A. Bornander	1941
Ruth Halasey	1941
Hugh C. Kirkpatrick	1941
John F. Schafer	1942
Neil A. MacLean	1943
Kirk Athow	1946
Clarence H. Sonderman Jr.	1948
Paul A. Johnson	1950
Allan R. Hoagland	1950
Clarence Piper	1950
John Y. Woo	1950

Master of Science

D. C. George	(In Bot.)	1916
B. F. Dana	(In Bot.)	1917
Walter J. Bach		1922
Chas S. Parker		1923
L. W. Boyle		1924
Carl H. Spiegleberg		1925
Roderick Sprague		1925
Geo. A. Newton		1927
Grover Burnett		1929
G. A. Huber		1929
Jess R. Kienholz		1929
Kenneth J. Kadow		1933
Earl J. Anderson		1934
Otto F. Schnellhardt		1935
E. L. Reeves		1937
Carl W. Boothroyd		1941

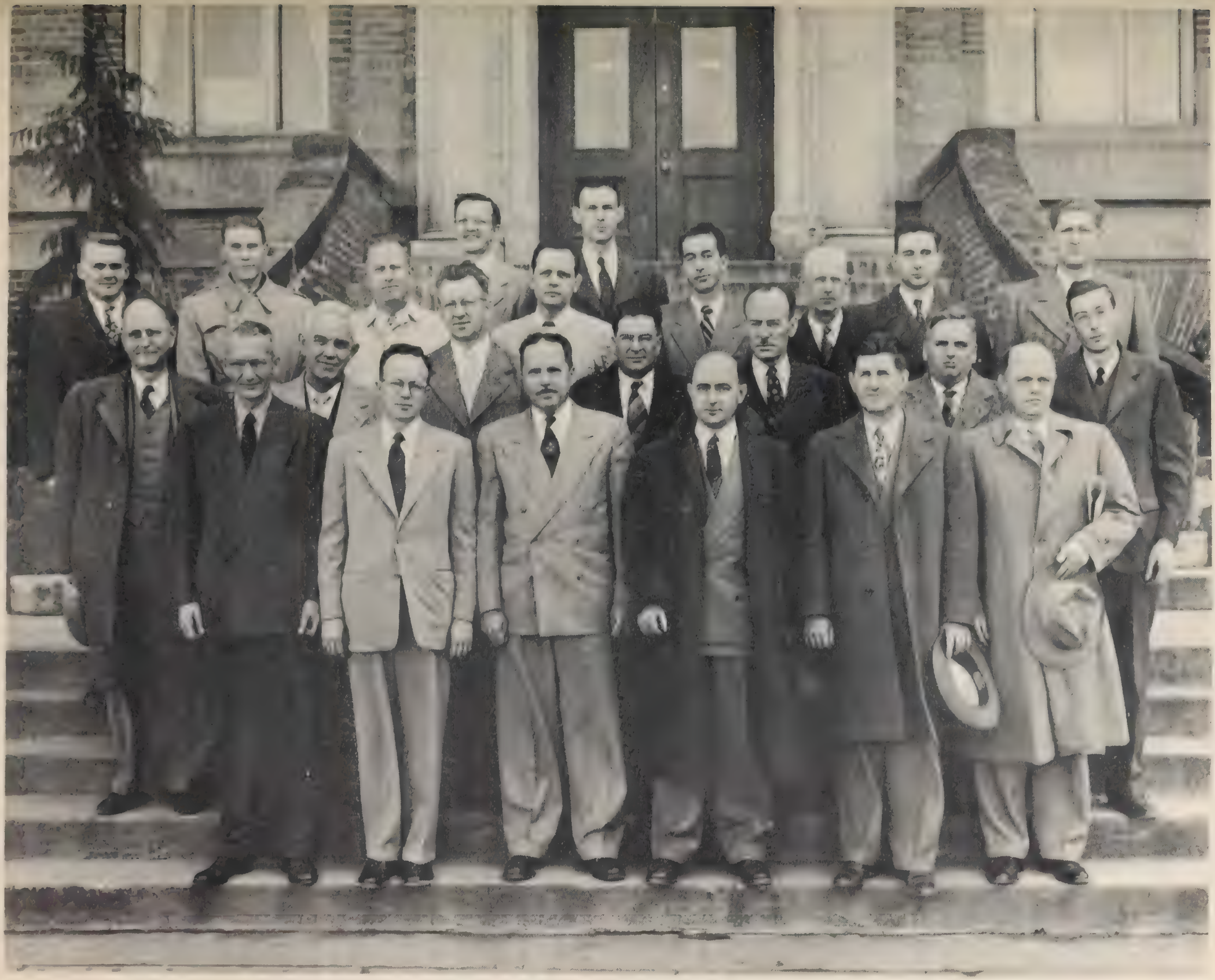
Ph.D.

George D. Ruehle	1930
G. A. Huber	1931
Grover Burnett	1932
Kenneth F. Baker	1934
Leo Campbell	1935
Folke Johnson	1939
Richard H. Wellman	1939
W. Harley English	1940
D. M. Coe	1943
S. I. Cohen	1943
J. D. Menzies	1943
Max L. Schuster	1945
George Nyland	1948
Conley V. Lowther	1948
Jack P. Meiners	1949
Neil A. MacLean	1949
Avery E. Rich	1950

Present Teaching Program

At the present writing, sixteen courses of instruction are offered:

P. P. 9 Practical Plant Pathology. 3 hours.
P. P. 27 Forest Pathology. 4 hours.
P. P. 29 General Plant Pathology. 4 hours.
P. P. 115 Vegetable Diseases. 3 hours.
P. P. 117 Diseases of Ornamental Plants. 3 hours.
P. P. 119 Fruit Diseases. 3 hours.
P. P. 121 Diseases of Field Crops. 4 hours.
P. P. 128 Mycology. 4 hours.
P. P. 129 Methods and Techniques. 4 hours.
P. P. 150 Field Mycology. (summer course) 2-3 hours.
P. P. 215 Seminar. 1 hour.
P. P. 219 Advanced Principles and Theory of Plant Pathology.
P. P. 228 Advanced Mycology.
P. P. 250 Field Plant Pathology (summer course) 2-3 hours.
P. P. 300 Research
P. P. 350 Thesis



Front row, left to right:
H. B. Busdicker,
C. J. Gould,
G. W. Fischer,
R. C. Lindner,
D. M. McLean,
Folke Johnson.
Second row, left to right:
M. R. Harris,
W. D. Courtney,
S. B. Locke,
Roderick Sprague,
Leo Campbell,
A. E. Rich,
J. D. Menzies.
Third row, left to right:
W. D. Yerkes,
J. P. Meiners,
R. C. Cummings,
S. W. Graham,
H. E. Williams,
E. C. Blodgett,
T. O. Diener,
J. G. Barrat.
Fourth row:
C. M. Wright,
H. H. V. Hord.
Absent:
C. S. Holton,
E. L. Reeves,
H. C. Kirkpatrick,
T. R. Wright.

FIGURE 1. Washington State Plant Pathologists. Picture taken on occasion of Washington Agricultural Experiment Station Conference, November 27, 1950.

Present Personnel

Although the formal teaching program is confined to the campus at Pullman, the research program is rather widely decentralized. Of the 26 full-time plant Pathologists in the State of Washington, ten are on the Pullman campus, five are at the Tree Fruit Experiment Station at Wenatchee, five are at the Irrigation Experiment Station at Prosser, four at the Western Washington Experiment Station at Puyallup, and one each at the Northwest Washington Experiment Station at Mount Vernon and the Cranberry-Blueberry Experiment Station at Long Beach. The complete roster of plant pathologists follows:

List of Full-time Plant Pathologists in the State of Washington
(As prepared for Office of Experiment Stations)

G. W. Fischer, Professor; Plant Pathologist; Chairman of Department; Agricultural Experiment Station, Pullman.

J. G. Barrat, Plant Pathologist and Entomologist, Washington State Department of Agriculture, Irrigation Experimental Station, Prosser.

E. C. Blodgett, Plant Pathologist, Irrigation Experiment Station and Washington State Department of Agriculture, Prosser.

H. B. Busdicker, Pathologist, U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, Pullman.

Leo Campbell, Assistant Plant Pathologist, Western Washington Experiment Station, Puyallup.

Wm. Bridge Cooke, Research Associate in Plant Pathology (Mycology), Pullman.

W. D. Courtney, Associate Nematologist, U. S. Department of Agriculture, Bureau of Plant Industry, Soils, and Agricultural Engineering, Western Washington Experiment Station, Puyallup.

D. J. Crowley, Associate Plant Pathologist, Cranberry-Blueberry Experiment Station, Long Beach.

T. O. Diener, Assistant Plant Pathologist, Irrigation Experiment Station, Prosser.

C. J. Gould, Associate Plant Pathologist, Western Washington Experiment Station, Puyallup.

M. R. Harris, Extension Plant Pathologist, Agricultural Extension Service, Pullman.

C. S. Holton, Pathologist, U. S. Department of Agriculture, Agricultural Experiment Station, Pullman.

Folke Johnson, Associate Plant Pathologist, Western Washington Experiment Station, Puyallup.

H. C. Kirkpatrick, Associate Pathologist, U. S. Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering, Tree Fruit Experiment Station, Wenatchee.

R. C. Lindner, Associate Plant Pathologist, Tree Fruit Experiment Station, Wenatchee.

S. B. Locke, Associate Professor and Associate Plant Pathologist, Agricultural Experiment Station, Pullman.

D. M. McLean, Associate Pathologist, U. S. Department of Agriculture, Bureau of Plant Industry, Soils, and Agricultural Engineering, Northwest Washington Experiment Station, Mount Vernon.

J. P. Meiners, Assistant Professor and Assistant Plant Pathologist, Agricultural Experiment Station, Pullman.

J. D. Menzies, Pathologist, U. S. Department of Agriculture, Irrigation Experiment Station, Prosser.

E. L. Reeves, Pathologist, U. S. Department of Agriculture, Box 99, Wenatchee,

A. E. Rich, Assistant Professor and Assistant Plant Pathologist, Agricultural Experiment Station, Pullman.

C. G. Shaw, Assistant Professor, and Assistant Plant Pathologist, Agricultural Experiment Station, Pullman.

Roderick Sprague, Plant Pathologist, Tree Fruit Experiment Station, Wenatchee.

H. E. Williams, Junior Plant Pathologist, Irrigation Experiment Station, and Washington State Department of Agriculture, Prosser.

C. M. Wright, Assistant Professor and Assistant Plant Pathologist, Agricultural Experiment Station, Pullman.

T. R. Wright, Associate Pathologist, U. S. Department of Agriculture, Box 99, Wenatchee.

Present Research Program

The research program itself is divided on the basis of various crops, insofar as this is possible. The distribution of responsibility indicated below includes service responsibilities as well as research in the various categories.

CEREAL DISEASES

Wheat:
- Bunt, including "stunt bunt or short smut" -- C. S. Holton (Physiologic specialization, inheritance of pathogenicity and comparative studies with similar grass smuts)
- Flag smut -- C. S. Holton (General physiological studies)
- Snow mold and snow scald -- Roderick Sprague (General biology and epidemiology of the causal organisms; control)
- Root rots -- J. P. Meiners (General biological factors influencing the incidence of these diseases)
- Stem rust -- H. B. Busdicker (Barberry eradication)

Barley:
- Covered smut -- C. S. Holton (General biology)

Oats:
- Loose and covered smuts -- C. S. Holton (Physiologic specialization; general biology of the causal organisms

Corn:
- Head smut -- G. W. Fischer and C. J. Mankin (Biology and epidemiology)

POTATO DISEASES

- Leaf roll -- S. B. Locke (Varietal resistance and susceptibility in cooperation with U. S. Department of Agriculture and the local Department of Horticulture; chemotheraphy; nature of leafroll resistance; varietal resistance to net necrosis development). Avery E. Rich (Field and storage factors influencing net necrosis; field factors influencing the incidence of leafroll). J. D. Menzies (Varietal resistance and susceptibility; comparative studies with other virus diseases confused with leaf roll)
- Scab -- J. D. Menzies (Influence of soil treatments and rotation on the incidence of scab; distribution of the organism in virgin soils). A. E. Rich (Influence of soil treatments on the incidence of the organism and severity of the disease, cooperative with J. D. Menzies)
- Miscellaneous virus diseases -- J. D. Menzies, A. E. Rich
- Late blight and early blight -- Avery E. Rich (Fungicidal control; field factors influencing incidence)
- Seed-piece decay -- Avery E. Rich
- Storage decays and tuber defects -- Avery E. Rich and E. C. Blodgett

DISEASES OF OTHER VEGETABLES

- Seed crops -- cabbage and beets -- D. M. McLean (White blight (Sclerotinia) of cabbage; mosaic of beets)
- Spinach -- C. M. Wright and W. D. Yerkes (Downy mildew in the Walla Walla district)
- Beans -- Leo Campbell (Rust; Botrytis blight; white blight)
- Beets -- Leo Campbell (Black root)
- Squash decays (in storage) -- Leo Campbell
- Seed treatment -- C. J. Gould (Under Western Washington conditions)

DISEASES OF OTHER FIELD CROPS

- Beans and peas -- J. P. Meiners (Blights and root rots)
- Alfalfa and sweetclover -- J. P. Meiners

DISEASES OF STONE FRUITS

- Virus diseases
  - Nursery stock improvement -- E. C. Blodgett, H. E. Williams, T. O. Diener, J. G. Barrat
  - Indexing studies -- E. C. Blogdett, H. E. Williams, T. O. Diener, H. C. Kirkpatrick

Transmission studies -- E. L. Reeves (Graft and bud transmission) E. C. Blodgett, H. C. Kirkpatrick, R. C. Lindner
General identification studies of stone fruit viruses -- E. L. Reeves, E. C. Blodgett, Folke Johnson, T. O. Diener
Physical and chemical identification of stone fruit viruses -- R. C. Lindner (Ultra-violet absorption spectra; Polyphenol tests)
Chemotheraphy (H. C. Kirkpatrick, R. C. Lindner)
Physical treatments for control of viruses -- H. C. Kirkpatrick, R. C. Lindner, E. C. Blodgett, H. E. Williams
Purification studies -- R. C. Lindner (Use of biochemical tests for the separation of individual components of a complex of viruses whose combined action gives certain definite recognized disease symptoms)
Effect of temperature on symptom expression -- H. C. Kirkpatrick (Determination of optimum temperatures for expression of disease symptoms)
Identification of viruses transmitted by insects -- R. C. Lindner (In cooperation with entomologists in their insect vector studies)
In vitro culture of viruses -- R. C. Lindner
Relationship of understocks to the expression of virus diseases -- E. C. Blodgett, T. O. Diener, J. G. Barrat, H. E. Williams
Brown rot -- Folke Johnson (Fungicidal control)
Peach leaf curl -- Folke Johnson (Fungicidal control)

DISEASES OF POME FRUITS

Apple mildew -- Roderick Sprague (Fungicidal control and life history studies)
Other fungus diseases of fruit trees -- Roderick Sprague
Fire blight -- Roderick Sprague
Decays in storage and transit -- T. R. Wright

DISEASES OF SMALL FRUITS

Strawberries -- Leo Campbell and Folke Johnson (strawberry yellows, "dud", and control of yellows and other virus diseases through suppression of insect vectors in cooperation with local entomologists)
Cane fruits -- Folke Johnson (rusts, blights, leaf spots, etc.)
Cranberries and blueberries -- J. D. Crowley, Folke Johnson (Fungicidal control of fungus diseases; influence of harvesting methods on the incidence of storage decays in cooperation with the Department of Agricultural Engineering)

DISEASES OF HAY AND PASTURE GRASSES

Turf diseases -- J. P. Meiners
Smuts and rusts -- G. W. Fischer, J. P. Meiners, S. M. Dietz, and W. N. Siang
Leaf spots -- Roderick Sprague, J. Y. Park

DISEASES OF ORNAMENTALS

Bulbous ornamentals -- C. J. Gould (in western Washington)
Greenhouse ornamentals -- C. M. Wright (chiefly in eastern Washington)

DISEASES OF FOREST AND SHADE TREES

Ponderosa pine blight -- Charles Gardner Shaw, George W. Fischer (caused by industrial gases)
Tar spot of large leaf maple -- George W. Fischer, John Y. Woo
Wood decay fungi -- C. G. Shaw, Wm. Bridge Cooke, H. H. V. Hord
Miscellaneous -- Charles Gardner Shaw

MISCELLANEOUS

Soil microflora of Columbia Basin virgin soil in relation to plant disease incidence -- J. D. Menzies
Peppermint rust -- Leo Campbell (Epidemiology and control; hife history studies)
Mycology -- Charles Gardner Shaw, Wm. Bridge Cooke
Enzyme chemistry of certain wood decays -- Charles Gardner Shaw, H. H. V. Hord
Bio-assay of ergot alkaloids produced in artifical culture -- C. M. Wright, R. H. Cummings (in cooperation with University of Washington)

Physiology of plant gall development -- S. B. Locke, Lafayette Frederick
Diseases caused by nematodes -- W. D. Courtney
Extension plant pathology -- M. R. Harris
Plant Introduction and Quarantine -- E. C. Blodgett, H. E. Williams
Influence of sprinkler irrigation on plant disease-- J. D. Menzies, J. G. Barrat
Soil-borne diseases as influenced by land management practices -- J. D. Menzies

SURVEY OF RESEARCH ACCOMPLISHMENTS

It is difficult to evaluate our own accomplishments subjectively, and believing that current work is better understood and will speak for itself, attention is given primarily in this section to achievements that preceded our present program.

We have, in the State of Washington, a rather closely knit and highly cooperative research program, involving participation by plant pathologists employed by Washington State College Experiment Stations, the United States Department of Agriculture, and the Washington State Department of Agriculture. When speaking, therefore, of the accomplishments of the Department, the participation of all three of these agencies is understood.

The written contributions to date number well over 500 scientific papers and bulletins, and more or less popular papers. In addition five books have been written by four members of the Department.

Outstanding among the research accomplishments is, of course, the contribution to the control of stinking smut or bunt of wheat. In the very early days of the Experiment Station, Professor Piper recorded the extreme prevalence and importance of wheat smut as causing tremendous losses to the wheat farmers. Furthermore, every year many threshing machines were ruined by explosion due to spontaneous ignition of the smut-laden atmosphere within the separator. The copper sulfate method of controlling wheat smut was proving ineffective and the formaldehyde treatment developed a few years later was not a great deal better. Dr. Heald and his associates demonstrated that this failure of seed treatment was due largely to "smut showers" resulting from the expulsion into the atmosphere of inestimable quantities of smut spores, which blew to nearby fallow fields and contaminated the soil. Special attention was given to methods of overcoming this soil contamination by cultural practices and date of seeding. Also, in cooperation with the local wheat breeders, much has been done toward the control of wheat smut through the breeding of resistant varieties. A number of years ago Robert Insinger, a prominent Spokane citizen, made the public statement that "If the State College of Washington had never done anything else except what they had contributed to the knowledge of methods of control of wheat smut, every cent which had been spent to date in the support of the College would have been justified." Numerous biological contributions have likewise been made in the study of the stinking smut of wheat. The work of Heald, Flor and Holton in demonstrating the existence of numerous physiologic races of wheat smut is now considered classic.

It is believed that the State of Washington can take credit for much of the knowledge on the nature and control of the Rhizoctonia disease of potatoes. Likewise, many studies have been made on the complex nature of the potato viruses. A classic contribution is the demonstration of the combined action of the vein-banding virus of potatoes and the latent virus to produce the destructive virus disease known as rugose mosaic. It is believed, also, that more recent contributions on the nature of potato leafroll and factors influencing its development, including net necrosis, are outstanding.

Much attention was given in the earlier years to the disease then known as western blight of tomato. Fifty to 75 percent losses due to this disease were common. For many years it was believed that the disease was caused by a fungus or bacterial organism, and species of Fusarium and Rhizoctonia were consistently isolated from the roots of the blighted tomato plants. At one time, it was published that the western blight was due to Fusarium oxysporum. Further work failed to confirm this, however, and it was then decided that a species of Rhizoctonia was the causal organism. Following Dr. Heald's arrival further investigations indicated that the disease was of virus nature, and it was later shown that the western blight of tomato is actually caused by the common curly top virus.

The streak disease of greenhouse tomatoes had long baffled growers and plant pathologists alike. L. K. Jones showed that this disease was due to tobacco mosaic transmitted to the tomato plants by greenhouse workers who used tobacco in one form or another.

Numerous contributions have been made by Heald and graduate students on the etiology and control of storage decays of Washington apples and pears. The most destructive of these were rots caused by blue mold and gray mold.

Also in the earlier years, many contributions were made on the identity, nature, and control of oat smuts in Washington, primarily by Heald and his associates.

Dr. Heald's demonstration of leaf invasion by fire blight bacteria is considered classic.

Leaf curl and mosaic, two virus diseases of geranium, had become prevalent in commercial stock of this greenhouse ornamental. Studies on these diseases showed that losses may be greatly reduced through careful selection of disease-free stock for propagation. Likewise, streak and mosaic, two virus diseases of cineraria, were studied in the earlier years. Jones showed that both of these diseases are seed-carried, and that the diseases can be controlled by careful selection of seeds from disease-free plants.

The nature and mode of transmission of the virus disease, witches' broom of alfalfa, was worked out by Menzies in association with Heald.

Campbell's study of black root of beets has shown that the disease can be controlled by crop rotation.

A great contribution was made toward the solution of the life history of the organism causing witches' broom of service berry. This was accomplished by Sprague in collaboration with Heald.

Several contributions have been made toward the solution of several disease problems affecting field peas and also green canning peas. Prominent among these are the Fusarium wilt, mosaics, and downy mildew, by Jones, Johnson and Campbell.

Another classic contribution was the demonstration by Heald and Sprague of the relationship between the incidence of silver leaf of apple trees (caused by Stereum purpureum) and winter injury.

Through the earlier work of Jones, Reeves, Menzies, and Huber, great strides were made toward a knowledge of the complex of virus diseases attacking our stone fruits and in methods of controlling them. These earlier contributions have been considerably augmented by recent work of Blodgett, Lindner, Kirkpatrick, Reeves, and their associates.

Many contributions have been made toward an understanding of various diseases of forage and range grasses by Sprague and Fischer.

The control of the destructive beet mosaic in northwest Washington seed beets has been accomplished by the simple method of isolating the foundation seed beet fields, based on the work of Pound and McLean. A similar contribution has been made toward the control of potato leafroll through the isolation of foundation fields for seed potato production, based on experiments by Rich and Locke.

Through the aggressive research activity of Gould many contributions have been made toward an understanding of the cause and control of various bulb diseases in western Washington.

The eradication of more than 120,000 barberry bushes from eastern Washington through the leadership of Busdicker is a noteworthy contribution by itself to the control of stem rust of wheat and other cereals.

Distinct contributions were made by Jones and later by Johnson on various diseases of raspberries, leaf rust (Phragmidium) of raspberries, and other bramble diseases.

Honorable mention is merited also by the work of the Moxee Plant Introduction and Quarantine Station under the earlier leadership of Coe, Menzies, and now Blodgett, to control virus diseases of stone fruit nursery stock by establishing and propagating virus-free bud wood sources.

Current contributions by the present staff are considered to be just as noteworthy as those of past years. However, we modestly refrain from "patting ourselves on the back". Some reference to current contributions will be made under the heading pertaining to the future.

? THE FUTURE ?

In these uncertain and troubled times any predictions for the future must be made with considerable reservations. In the foregoing pages we have seen the development of plant pathology in the State of Washington from the modest beginning where C. V. Piper was expected to handle the entire fields of Botany and Entomology in the College and Experiment Station in 1893, to the present time where we now have 26 full-time plant pathologists in the State with a great degree of subject-matter specialization. How much further development and specialization is possible and likely to occur is not safe for anyone to predict. In spite of the present comparatively large staff, there still remains a multiplicity of plant disease problems and all of the staff are probably as busy as were their much less specialized predecessors.

However, barring economic catastrophe, it would seem safe to predict that Lindner, Blodgett, Reeves, Kirkpatrick and their associates will continue to make outstanding contributions toward our knowledge of the components of the complex of virus diseases attacking stone fruits. It can be predicted that Locke, Rich, and Menzies in cooperation with entomologists and horticulturists will continue to make contributions toward the identity and control of the components of the potato virus complex. Holton and his associates can be expected to solve the problem on dwarf smut of wheat, which now defies control except through the medium of resistant varieties. Campbell and cooperating entomologists will make further contributions on the control of strawberry yellows by suppressing the aphid vector. The current contributions toward the control of diseases of bulbous crops by Gould can be expected to continue.

It can also be expected that through the efforts of Menzies, McLean, and others much information will be obtained toward our knowledge of soil borne organisms and their relation to plant diseases and their control.

Present research on the effects of industrial gases on economic plants, by Shaw, Johnson, and cooperating chemists, can be expected to yield outstanding contributions in this currently important field.

Current research by Lindner, Kirkpatrick, and Locke on the chemotherapy of plant viruses, and by Lindner on chemical detection of viruses in plant tissues, has tremendous potentialities.

However, it must remain for the hindsight of someone in the future rather than the foresight of us in the present to record the present and future contributions of Washington State Plant Pathologists effectively.

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